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# THE SURGICAL CLINICS of NORTH AMERICA

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LAHEY CLINIC NUMBER

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## *SYMPOSIUM ON DISEASES OF THE SPLEEN, BILIARY TRACT, LIVER AND PANCREAS*

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### **SURGICAL CONDITIONS OF THE SPLEEN**

FRANK H. LAHEY

If one could be more certain of the functions of the spleen it would be much easier to rationalize any discussion of when splenectomy is worth doing.

The real function of the spleen has never been soundly established. Over the years, there have been constantly changing conceptions as to what part the spleen plays in the bodily function and even though we know much more about the spleen than we did not too many years ago, and even though some of the misconceptions concerning the value of splenectomy have been corrected, there are a limited number of abnormalities of the spleen in which splenectomy is indicated as a straightforward procedure with the benefits established by post-splenectomy observations as consistently satisfactory.

Expansion and contraction appears to be one of the certain demonstrable functions of the spleen owing to the fact that it is capable of holding a good-sized fraction of the total amount of blood in the circulation, and also to the fact that it contains nonstriated muscle fibers, large vascular spaces and that by the injection of 1 cc. of epinephrine, definite contraction of the organ can be brought about with the expulsion of a large amount of blood into the blood stream.

Hardly anyone has ever written on the subject of splenic diseases without referring to the habit of the ancients of performing splenectomy upon long distance runners on the basis of its making possible the acquirement of a greater amount of stamina. To me as a surgeon this is a remarkable observation since the blood supply of the spleen is quite inaccessible and its control by ligature is by no means easy. One can

only suspect how high the mortality must have been and wish for more accurate details about whether or not it was actually done and how. It has likewise been suggested by writers on this subject that the pain in the left hypochondrium, which runners are accustomed to have, may be the result of overdistention of the spleen from the accumulation of excessive amounts of blood in it. At any rate, it is very probable that, particularly in single, massive hemorrhages, the spleen is capable of promptly supplying the circulation with an additional amount of blood from its reservoir within the spleen.

That the spleen, with its reticulo-endothelial equipment, plays some part in blood destruction has been suspected, but not proved, for a number of years. Castle and Minot have commented on the destruction of blood cells and that it is still uncertain as to how it is brought about; whether it is due to phagocytosis because the destruction is accomplished by the reticulo-endothelial system or by fragmentation and lysis in the blood stream, they state, is not known. It is known, however, that bilirubin, a breakdown product of hemoglobin, is present in greater quantities in the blood coming from the spleen and from the bone marrow than blood entering these organs. From this they suggest that an important function of the spleen may well be the conservation of such products of red cell destruction for their use in subsequent formation of new red cells and hemoglobin.

In certain diseases, such as idiopathic thrombocytopenia, it is known that the blood platelets are low, that it is impossible to increase them by any measure other than splenectomy and that following splenectomy they rise with dramatic rapidity. It is now, however, quite well established that the origin of the blood platelets is in the bone marrow from the megakaryocytes and that the effect of splenectomy may well be the removal of a hormonal depressant originating in the spleen. It is certain that such dramatic rises of blood platelets from counts of 50,000 on the morning of the operation to 350,000 in the afternoon or evening following the removal of the spleen can be brought about only by removal of some factor that is depressing their production in the place where they are now known to be developed, the bone marrow.

The splenic states in which surgical removal of the spleen is now to be unhesitatingly considered may be listed in one group and those in which splenectomy is to be considered with reservations and diagnostic caution, in another group, as follows:

*First Group: Splenic States in Which Splenectomy Is Indicated*

- Rupture of the spleen
- Ptosis and torsion of the spleen
- Cysts of the spleen
- Tumors of the spleen
- Abscess of the spleen
- Malarial spleen
- Splenectomy included in total gastrectomy

*Second Group: Splenic States in Which the Indications for Splenectomy Are Not Always Clear*

Familial hemolytic jaundice (hereditary)  
Idiopathic thrombocytopenic purpura  
Splenic neutropenia  
Primary splenic panhematocytopenia  
Banti's disease with limitation  
Gaucher's disease (selected cases)  
Hodgkin's disease (selected cases)

**SPLENIC STATES IN WHICH SPLENECTOMY IS INDICATED**

**Rupture of the Spleen.**—Owing to the fact that the spleen rests beneath the left hypochondrium close to the chest wall, a position even more superficial than the kidney, and because, exclusive of peritoneal attachments, it hangs by a pedicle in which are its supplying vessels, it will be in constant danger from all types of accidents of a crushing character, those involving blows upon the abdomen or transmitted forces of an impulse character. The symptoms of ruptured spleen may be those of intraperitoneal hemorrhage or those of extraperitoneal hematoma when the fracture of the spleen is cortical, since a large portion of the spleen is extraperitoneal where it rests against the lateral and posterior abdominal wall. Since the spleen rests directly over the upper surface of the kidney, one should never fail, should operation be undertaken for a ruptured spleen, to investigate the kidney since any force capable of tearing off or rupturing the blood supply of the spleen must in its course also be delivered to the region of the left kidney and result occasionally not only in rupture of the spleen but rupture of the kidney.

The technical procedure of splenectomy for ruptured spleen is inelegant but effective. With wide exposure through whatever type of incision one chooses—we have always been well satisfied with long left rectus incisions—the spleen is rapidly freed from its lateral peritoneal attachment, turned up into the wound together with the tail of the pancreas, its pedicle clamped, taking care to avoid the tip of the pancreatic tail, and both vessels ligated *en masse*. Wide incision and good anesthesia, particularly the added relaxation obtained with curare, make it possible following the removal of the spleen to control the hemorrhage, visualize the front surface of the kidney, the adrenal, to demonstrate whether or not hematoma is present around the kidney and to remove that organ through the same incision without difficulty, should the exposure demonstrate this necessity. With this wide exposure of the parietal peritoneum from which the spleen has been freed, small bleeding vessels in the posterior wall of the abdomen and running to the greater curvature of the stomach can be found, clamped, and a dry field obtained.

**Pto-sis and Torsion of the Spleen.**—Pto-sis and torsion of a wandering spleen have frequently been reported in the literature. I have

personally operated upon one patient whose spleen had migrated to the left iliac fossa and there became twisted. Ptosis and torsion of the spleen, while by no means common, have been reported in the literature repeatedly over the years.

The treatment of ptosis or torsion of the spleen should be splenectomy since removal of the spleen is without serious effect. Furthermore, there are no ligamentous structures of worthwhile value attached to the spleen by which it can be so suspended with any good prospect of its remaining in place. The various ligaments of the spleen which have been described are really not ligaments at all but thickened *ridges of peritoneal reflections* running to the diaphragm, known as the splenophrenic ligament, the ligaments to the stomach or to the region of the kidney.

**Cysts of the Spleen.**—Cysts of the spleen are of not infrequent occurrence. Exclusive of the hydatid cysts, which are not common in this country, they are most commonly retention cysts. While they do not occur with any degree of frequency, in any clinic where many splenectomies are done an occasional splenic cyst will be found, as was the case recently in our own experience. There have been 4 patients with large cysts of the spleen in our experiences, all treated by splenectomy, the accepted method in this condition.

**Tumors of the Spleen.**—Tumors of the spleen, exclusive of lymphomas, are rare. In fact, it has been one of the frequent comments of those who have been interested in splenic disease that the spleen is not more often the site of metastatic implants. Because of the rarity of this occurrence it has even been suggested that the spleen itself possesses some protective element or factor against malignant disease or that, because of its rhythmic contractions and large spaces, it is impossible for malignant cells to lodge in it.

Of the occasional tumors occurring in the spleen the two most frequently encountered are those associated with Hodgkin's disease and lymphosarcoma.

**Abscesses of the Spleen and Malarial Spleen.**—Abscesses of the spleen and the malarial spleen require little discussion based upon experiences in this part of the world. Abscesses found in the spleen are most commonly associated with general septic processes. The large caked malarial spleen is not a problem in a community where malaria is now almost unheard of and, when it occurs, is not of the type and character that produces caked spleen, with its tendency to rupture, as occurs with tropical malaria.

**Splenectomy Included in Total Gastrectomy.**—There remains to be discussed a comparatively new aspect of the problem of splenectomy and that is its inclusion with operative procedures for conditions other than those within the spleen itself: (1) for the purpose of radicalness of removal of malignant lesions, such as carcinoma of the stomach, and (2) for the purpose of increasing ease of exposure as in total gas-

trectomy, abdominal repairs of diaphragmatic hernia or the inclusion of the spleen in incarcerated diaphragmatic hernias, with the spleen incarcerated as one of the viscera which have migrated into the chest cavity. Splenectomies are now included in a great many, if not the

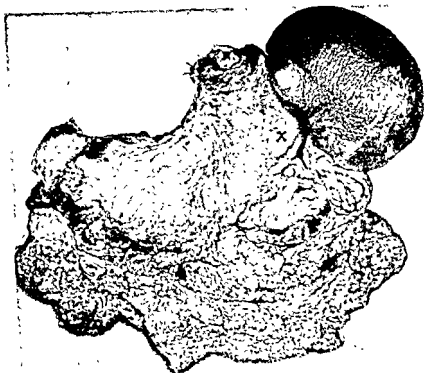


Fig 161 —Note in this specimen of total gastrectomy how removing the spleen with the stomach and omentum (1) adds to the radicalness and (2) increases the exposure

Note the malignancy along the greater curvature opposite the hilum of the spleen, marked "X."

majority, of the transthoracic resections for malignancy of the lower end of the esophagus or the upper end of the stomach.

We have now done over 60 splenectomies in the course of other operative procedures included in the above-mentioned group.

A number of years ago I proposed that splenectomy be added to all total gastrectomies (1) in order that its radicalness could be increased, and (2) because it added so materially to the ease of exposure of the esophagus and anastomosis of the jejunum to it, by means of which the remaining alimentary tract was reestablished.

Splenectomy is a very valuable additional step, in my opinion, in the performance of total gastrectomy, an operative procedure which has now become well established in terms of its possibility of prolonging life or even cure of an advanced malignant lesion of the stomach and also in terms of its reduced and very reasonable mortality rate, now under 10 per cent.

Since most total gastrectomies will be done for malignancies of the linitis plastica type of carcinoma which involve practically all of the stomach or for the lymphosarcomas of the intramural type involving a good portion of the stomach, or for the leiomyosarcomas, also involving a large part of the stomach, it will be obvious that if the spleen be separated from its position along the upper portion of the greater curvature, this separation will frequently be done very close to the malignancy which so frequently channels along the greater curvature and can often be seen as a thick, white, infiltrating pathway in this region.

It is further to be realized in attempting very radical removals of the malignant lesions which completely infiltrate the stomach that it is desirable to remove not only all of the stomach, but also all of the greater omentum including the spleen's position in it, since there will frequently be metastatically involved nodes within the omentum. The best way to add omentumectomy to total gastrectomy is to leave the spleen, as shown in Figure 161, attached to the omentum, to ligate the splenic vessels, to leave the vasa brevia running from the spleen to the stomach unsevered, thus completely removing all of the greater omentum and, with the stomach turned up, making it possible to include also all of the gastrohepatic omentum with ligature of the gastric artery close to its origin.

Not only does the splenectomy combined with omentumectomy and total gastrectomy add to the radicalness of this procedure, but with the removal of the spleen it makes exposure of the diaphragm, mobilization of the esophagus and the anastomosis between the jejunum and the esophagus very much easier and, because of its visualization, very much safer.

When we first began doing splenectomies in such a large number of total gastrectomies, now over 100, our hematologists were a little disturbed concerning the possible effect of this additional step upon the blood picture, but a review of these cases has shown that it possesses no disadvantages and many advantages.

In transthoracic resections of the lower end of the esophagus, the addition of splenectomy is even more valuable, with its added exposure and its added contribution to radicalness in malignant lesions, than in its addition as a step in total gastrectomy.

Because of the large number of splenectomies which we have now done, we have never had any hesitation in adding omentumectomy and splenectomy to any of the radical procedures which we have

employed for the above-stated conditions for the purpose of increased radicalness or better exposure.

### SPLENIC STATES IN WHICH THE INDICATIONS FOR SPLENECTOMY ARE NOT ALWAYS CLEAR

**Familial Hemolytic Jaundice.**—Of the second group of cases in which the indications for splenectomy are at times not clear, congenital hemolytic jaundice stands out as the disease in which splenectomy is most consistently satisfactory. There is universal agreement concerning the wisdom and the satisfactory end results which may be obtained by means of splenectomy in this condition, which is characterized by jaundice that is the result of the destruction of red blood cell corpuscles, a pronounced anemia, red cells of a spheroidal type and an increased fragility rate. It is sometimes also known as spherocytic anemia.

In familial hemolytic jaundice there is always enlargement of the spleen. At times it is not of great size although usually it is of such size as to be plainly palpable beneath the rib edges.

This disease is also characterized by the frequent association of gallstones and the not infrequent occurrence of acute episodes.

Splenectomy when the diagnosis is correct is a most satisfactory form of treatment for this condition. If the operation is not undertaken during an acute episode but at a later date, depending on the patient's condition, and if the gallbladder which contains stones is also removed, it is followed by recovery from the anemia and relief from the jaundice, without other treatment.

**Idiopathic Thrombocytopenic Purpura.**—Idiopathic thrombocytopenic purpura is second in this group in which splenectomy is so satisfactory. One has to have in mind certain reservations concerning this condition, one of which is the need of being careful to differentiate this type of purpura from those cases of thrombocytopenia secondary to other conditions.

Idiopathic thrombocytopenic purpura is rarely associated with enlargements of the spleen of any considerable size and the spleen may be less than normal size.

This is a condition in which hematologists can usually settle the diagnosis. There are, however, confusing groups in which the decision as to the diagnosis and wisdom of splenectomy is not easy. In this relation, it has wisely been said that so excellent and consistent are the results following splenectomy for idiopathic thrombocytopenic purpura, when they are not good it is probable that the diagnosis of the type of purpura was not correct.

The difficulty and dangers in the management of these cases during the acute stage have been great. We have been materially aided by good preparation of the patients by the hematologic department in the



clinic by means of transfusions, and the adequate employment of iron and proper dietary preparations prior to the splenectomy.

I know of no group of cases in which wide exposure with adequate incisions, complete relaxation and anatomical control of blood supply pay higher dividends than in the splenectomies done during the acute stage of thrombocytopenic purpura. Splenectomies done for thrombocytopenic purpura during the chronic stage possess few complicating technical hazards.

There is one warning which should be stated concerning splenectomy for idiopathic thrombocytopenic purpura, and that has to do with delay. Once the diagnosis is established, it must be realized that splenectomy must eventually be done in order to bring about relief and that delay results only in exposure to a possible acute episode with all of the hazards that go with it and the high mortality associated with splenectomy when it is done as an urgent procedure, as it frequently must be during an acute episode of the disease.

**Splenic Neutropenia.**—Primary splenic neutropenia is a disease described by Wiseman and Doan in 1912, in which there is associated well-marked neutropenia and splenomegaly, demonstrating, as these authors have stated, the capacity of the spleen not only to destroy erythrocytes as in hemolytic icterus, influence the destruction of platelets as in thrombocytopenic purpura, but also to destroy or inhibit the production of white cells and produce a splenic neutropenia as occurs in this state.

Splenectomy in this disease is definitely indicated and has been followed by satisfactory results in the limited number of cases in which its use has been reported.

**Primary Panhematocytopenia.**—In the above paragraphs we have discussed the value of splenectomy in those conditions resulting in red blood cell destruction, hemolytic icterus, those conditions resulting in diminished number of platelets, thrombocytopenia, and those conditions resulting in a diminished number of neutrophils, primary neutropenia. Under the heading of primary panhematocytopenia are included those cases with all three of the features occurring at one time. To this Doan and Wright have given the name panhematocytopenia.

A secondary state of panhematocytopenia may occur in association with other processes involving the spleen, such as Hodgkin's disease and Gaucher's disease. We have had one example of the latter condition in which splenectomy brought about prompt improvement of the abnormal blood picture together with relief of the mechanical embarrassment so often occasioned by the large spleens present in this condition. In those states in which panhematocytopenia occurs as a result of primary disease of splenic origin, splenectomy will be followed by striking and lasting results, with prompt and striking rises in white blood counts, red cells and blood platelets. In those in which the state

is secondary to other lesions the improvement will, of course, be definite but temporary.

**Banti's Disease.**—Under a debatable heading comes splenectomy for Banti's disease. The question of the value of splenectomy in Banti's disease is much less satisfactorily settled than in the previously discussed groups of cases. As was said at the beginning of this discussion, it is extremely difficult to rationalize splenectomy when one does not know the function of the spleen satisfactorily, and it is doubly difficult to rationalize splenectomy in a disease such as Banti's disease when its etiology is so unclear and so unsoundly established.

It is not the purpose of this discussion of the surgical application of splenectomy to discuss at any length the diagnosis of these conditions.

Banti's disease may be divided into the stage associated with splenomegaly and a secondary type of anemia or splenomegaly before the anemia has occurred. The second stage is associated with splenomegaly, secondary anemia and evidences of cirrhosis and, finally, a third stage—splenomegaly, anemia and ascites.

The indications for splenectomy in this disease, characterized as it is by splenomegaly, leukopenia and not infrequently splenic thrombosis, have changed within the last few years. While it must be admitted that, unlike the two previous diseases, splenectomy is not consistently followed by satisfactory results, and not infrequently is followed by recurring hemorrhages from esophageal varices and the progressive development of cirrhosis, it is our feeling that, if the diagnosis can be made early, splenectomy which now can be done with such a low mortality rate is indicated because of its propensity at least to lessen the load on the portal circulation and the possibility that it will defer or prevent the hemorrhages associated with esophageal varices and delay the development of portal cirrhosis.

As is evidenced from the vagueness of the above statement, it must be admitted that the results of splenectomy when done late are extremely disappointing, that even those splenectomies done in the intermediate stage of Banti's syndrome are far from satisfactory, and that the splenectomies done in the earliest and most desirable stage of this disease are done largely because there is nothing else to do, because it is hoped that the removal of the spleen, which it is known will later enlarge as evidence of a pathologic process within it, may delay or defer the later stages of the disease which will be evidenced by portal cirrhosis.

**Gaucher's Disease.**—We have had one case of splenectomy in Gaucher's disease in which the results have been temporarily quite satisfactory. In Gaucher's disease, characterized by splenomegaly usually from childhood, typical reticular cells demonstrable by sternal puncture and by roentgenologic stigmata in the bones, splenectomy is of value when because of the size of the spleen the patient is distinctly uncomfortable and when, as frequently happens, the secondary effect

of the disease upon the spleen brings about the state of panhematocytopenia described under that heading.

#### COMMENT

It is our feeling that splenomegaly is an evidence of abnormal pathology and that when it is of such a degree as to make the spleen readily palpable below the rib edges, even though no abnormal blood changes are present, one should begin to consider the value of splenectomy and balance the very limited mortality which now goes with this operation against the later possible progress of the process which is inciting the splenomegaly. It is obvious that this is a far from accurate statement in an attempt to rationalize splenectomy under such conditions. We must admit, however, that we know relatively little about how splenic diseases bring about their undesirable effects, and that in splenomegaly such a majority of instances are associated with later, progressive and undesirable effects that, when the operation can be done with such a low mortality and is followed by no undesirable changes in the blood picture, and further when one realizes that splenectomy, if it is to be done in any of the diseases brought about by abnormal splenic physiology, is better done as early as possible, we then feel quite strongly that splenectomy in splenomegaly alone is well worth considering.

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## DIAGNOSIS OF DISEASES OF THE GALLBLADDER

DAVID McC. McKELL, JR.

BECAUSE the treatment of choice for a diseased gallbladder usually is its surgical removal, every effort should be exercised to arrive at an exact diagnosis. Since gallbladder disease is frequently progressive in its threat to life, diagnosis should be made as soon as is consistent with care and thoroughness. On the other hand, a needless surgical procedure is to be heartily condemned. It is a risk to the patient's life, economically costly to him and, if his symptoms persist after operation, an embarrassment to the attending physician and surgeon.

### CHRONIC CHOLECYSTITIS AND CHOLELITHIASIS

These manifestations of gallbladder disease go hand in hand. Stones are found in 90 to 95 per cent of chronically infected gallbladders. Some degree of chronic infection is invariably reported by the pathologist in gallbladders removed for stones. The symptoms are almost indistinguishable, and both apparently can give rise to acute cholecystitis.

*History.*—The patient complains of upper abdominal discomfort varying from a mild distress to a severe, knifelike pain or pressure. This discomfort is at times related to a large meal but may not ensue for many hours. On close questioning of the patient, the most severe discomfort will be found to be in the right upper quadrant or midepigastrium. It is rarely in the lower chest or back. It is almost never to the left of the midline or in the lower part of the abdomen. It may extend to these regions, although typically it extends to the back at the tip of the right scapula. It does not move about the abdomen. Most patients will have been awakened at night on at least one occasion. Vomiting is common but gives only partial relief. Frequently there is accompanying constipation. It is important to sift the symptoms referable to constipation and an irritable bowel from those of gallbladder disease as the former will not be relieved by cholecystectomy. The migratory cramps and vague indigestion of the irritable bowel are often more distressing than the more severe, but rarer, pains of biliary colic. If the former are the chief complaint, the patient should be advised before operation that he will need further treatment after the correction of the disease of the biliary tract.

*Physical Examination.*—An obese, middle-aged, multiparous female is afflicted in about two-thirds of cases, but thin young men are not exempt. As a severe attack subsides, there is likely to be localized tenderness over the gallbladder for several days. A faint tinge of icterus may be present owing to edema involving the common bile duct, but any deeper jaundice is likely to signify a stone passing down the common duct.

*Laboratory Studies.*—Properly performed duodenal biliary drainage is very useful.<sup>1</sup> Cholesterol crystals or calcium bilirubinate pigment are highly suggestive of cholelithiasis. When both are found they are almost diagnostic. Slight elevation of the serum bilirubin may be present, but a level of over 2.0 mg. per 100 cc. suggests an obstruction of the common bile duct. The leukocyte count may be slightly elevated. It should be watched closely as a rising count may be an important hint of superimposed acute cholecystitis.

*Roentgen Examination.*—Typically ringed or faceted shadows in the region of the gallbladder are seen at times on a flat film of the abdomen. About 80 per cent of stones cannot be positively identified without a cholecystogram.

Cholecystography is the most reliable single diagnostic weapon. In a high percentage of cases stones will be demonstrated within the gallbladder. An homogenous gallbladder shadow of good density almost excludes gallbladder disease. A rare case is encountered in which the density of the stones exactly matches that of the dye-filled organ. A patient with an absolutely typical history or with severe pain, other diseases having been excluded with reasonable certainty, may have to have an exploratory laparotomy. It is in this group that biliary drainage is particularly valuable. The condition is so uncommon that it would be well to acquaint the patient with the possibility of a negative result.

We do not consider a "faintly shown," "poorly concentrating," or "poorly emptying" gallbladder to be organically diseased if stones are not demonstrated. It is occasionally necessary to repeat such a study to secure good enough visualization to rule out a stone.

Nonvisualization of the gallbladder and a typical history means chronic cholecystitis, usually with cholelithiasis, in 95 to 100 per cent of cases.

The patient whose gallbladder is not visualized and who has an indefinite history constitutes a problem. There are several explanations other than disease to be kept in mind. The patient may not have taken the dye tablets, he may have vomited them, or they may have caused enough diarrhea to interfere with proper absorption. When these possibilities have been excluded, one must decide whether failure to visualize the organ is due to disease primarily within it or to other disorder. A duodenal ulcer, an irritable bowel, and possibly other gastrointestinal diseases can interfere enough with dye absorption to cause nonvisualization. The concomitant disease should be treated for from two to four weeks and the cholecystogram repeated. In a goodly percentage of cases one will be rewarded with a normally visualized gallbladder shadow. When the history and cholecystogram are not typical, even though no other disease be found, treatment with a bland moderate residue diet, antispasmodics and avoidance of laxatives for one month will often give the same result. The loss of one month in

removal of a diseased gallbladder is seldom hazardous. If doubt is still present, an intravenous cholecystogram may be necessary. The procedure is not without danger. It is contraindicated in patients with coronary artery disease, hypertension, severe hypotension or moderate liver disease.

All patients should have roentgenologic study with barium meal before operation is performed. The pain of a duodenal ulcer or of gastric malignant disease may simulate gallbladder disease. Such lesions can be missed by a surgeon at operation, and a gallbladder containing asymptomatic stones be removed instead of the attack being leveled at what may be a more serious lesion.

*Differential Diagnosis.*—In cases of irritable bowel the discomfort is more likely to be diffuse and migratory. There is usually alteration of bowel habit. The pain rarely awakens the patient from a sound sleep. It must be remembered that the two diseases often exist together.

In *peptic ulcer* there is usually periodicity and food relief. The pain may be in the right upper quadrant of the abdomen and go through to the back, but it is more a gnawing discomfort than the severe pressure or knife-like pain of gallbladder disease. Roentgenologic study with barium meal and cholecystogram will settle the question.

*Chronic or recurrent pancreatitis* presents more difficulty. It is frequently associated with cholelithiasis. There is likely to be more weight loss. Diarrhea rather than constipation accompanies it. The pain is more diffuse, slightly lower, and is more likely to be referred to the left back than in cases of cholelithiasis. During an attack the serum amylase is usually elevated.

Coronary artery disease, cirrhosis or malignant disease of the liver, malignant disease of the gastrointestinal tract, partial intestinal obstruction, and right renal disease must be considered but are usually excluded without difficulty.

### ACUTE CHOLECYSTITIS

*History.*—Acute cholecystitis usually is a sequel to chronic cholecystitis. Gallstones are present in 90 per cent of cases. A carefully elicited history will reveal past attacks of right upper abdominal pain or distress in over 80 per cent. The present attack may be no more severe in intensity at first, but is more prolonged. There is a severe systemic reaction. Chills are common, malaise pronounced, and nausea and vomiting occur in over 90 per cent of cases. At times the urine may appear darker and the stools lighter. This is rarely marked unless the common duct contains a stone.

*Physical Examination.*—A temperature of 100° to 102° F. is the rule, but it may be higher or normal. A continuing rise suggests gangrene of the gallbladder with impending perforation. The sclerae may or may not be slightly icteric. Since these patients are frequently seen by artificial light, slight jaundice is easily overlooked. The gallbladder

region is almost always tender. Such tenderness may be masked by splinting of the upper abdominal muscles. Occasionally a blow with the heel of the hand over the lower portion of the liver in the midaxillary line is necessary to elicit the sign. If there is no spasticity, a tender mass may be palpable in about a third of the cases.

*Laboratory Studies.*—The leukocyte count is usually elevated to from 12,000 to 20,000 cells per cubic millimeter. A normal count does not exclude the diagnosis. A steadily rising count is an indication of threatening or actual perforation.

*Roentgen Examination.*—The gallbladder may be visualized faintly by the Graham test.<sup>2</sup> A plain film of the abdomen may not only show stones, but also show signs of paralytic ileus, indicative of peritonitis from perforation. Occasionally roentgen examination after a barium meal or enema is necessary to rule out disease of the gastrointestinal tract.

*Differential Diagnosis.*—*Acute appendicitis*, especially in the obese, may give the same physical signs. The history of previous attacks of biliary pain is of great help. Nausea and vomiting are not likely to be as prominent in cases of appendicitis. Elevation of the bilirubin or the slight degree of icterus seen at times does not occur in appendicitis. Pain in the subscapular region is not found in appendicitis. The palpable, tender mass of acute cholecystitis is likely to be near the midline, whereas an appendiceal abscess is likely to be lateral. There may be resonance of the cecum overlying a deeply seated appendix, whereas the enlarged gallbladder lies anterior to the colon. At times administration of an anesthetic agent will relax the muscular spasm enough to allow palpation of an enlarged gallbladder. Rarely, the differentiation is impossible.

*Acute pancreatitis* presents the same problem as in the more chronic forms of the two diseases. The past history of pain in the right upper quadrant of the abdomen suggests biliary disease, but a high percentage of patients with pancreatitis have gallstones. The onset is more abrupt in pancreatitis than in cholecystitis. Early in pancreatitis the temperature is lower and the degree of shock greater. The amylase and lipase in the serum are elevated in acute pancreatitis.

In *perforated peptic ulcer*, the past history of periodicity and food relief is of great assistance. The abdomen is more rigidly boardlike. The temperature is not as high until peritonitis has set in. Air can be demonstrated beneath the diaphragm in about 50 per cent of cases.

*Other diseases* less commonly confused are pleuritis at the base of the right lung, carcinoma of the hepatic flexure with perforation, pyelonephritis, mesenteric thrombosis, coronary occlusion and volvulus.

#### PERFORATION WITH PERITONITIS

Although this complication greatly darkens the prognosis, the diagnosis of *perforation* rarely is made preoperatively. Sanders made the

diagnosis in 4 of 46 consecutive cases, although it was suspected in a few others.

There is nothing in the history of patients with acute cholecystitis to indicate in whom perforation will occur. Increase in the size or tenderness of the gallbladder, deepening of the toxic state, or rising leukocyte count and temperature are suggestive but not diagnostic. All patients with acute cholecystitis should be hospitalized and examined repeatedly. Older patients are somewhat more prone to perforation and are likely to show less reaction to the acute process. They should be observed with the greatest suspicion. When obvious signs of peritonitis have developed, the diagnosis is easy but it may be too late to help the patient.

### PERFORATION WITH INTERNAL BILIARY FISTULA

In some patients the gallbladder perforates into the stomach, duodenum, colon or liver without causing more than a localized peritonitis. These patients are more likely to recover from their acute attack but frequently suffer a greater degree of disability afterward. It may be impossible to establish the time of perforation.

*Physical Examination.*—In the early stage of fistula formation the acute cholecystitis is subsiding. Tenderness and thickening persist for varying periods of time depending upon the success of the spontaneous internal drainage.

*Laboratory Studies.*—They are of little help after inflammation has subsided.

*Roentgen Examination.*—The gallbladder is visualized rarely with a Graham test. Air in the liver radicles establishes the diagnosis. Quite frequently, barium will flow into the fistulous tract in the course of a barium meal or barium enema.

### HYDROPS OF THE GALLBLADDER

Hydrops usually occurs only in cases of long-standing cholelithiasis. If the cystic duct becomes blocked, and the retained fluid remains sterile, the gallbladder becomes distended. This gives rise to a mass, often palpable, in the right upper quadrant. In contrast to acute cholecystitis, the mass is only slightly tender and the patient is not acutely ill. The cholecystogram will show nonfunction of the gallbladder.

### BENIGN TUMORS OF THE GALLBLADDER

Polyps are infrequently demonstrated by cholecystography. They are more frequently found in gallbladders removed for other reasons. Other benign tumors are a great rarity and cause no clinical symptoms. When they cannot be differentiated reliably from small carcinomas, the final diagnosis should rest with the surgeon or pathologist.



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# THE DIFFERENTIAL DIAGNOSIS OF JAUNDICE

S. ALLEN WILKINSON

GIVEN a case of apparent jaundice, the first problem to decide is whether the patient actually has jaundice. Many patients believe they are jaundiced when they are merely sallow. This is quickly answered by inspection of the conjunctivae in daylight, by a foam test of the urine

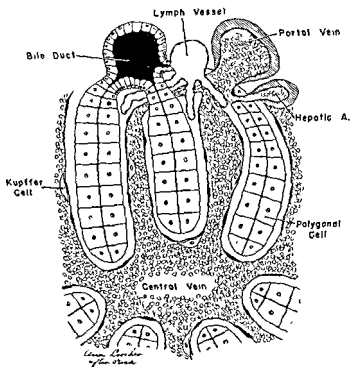


Fig 162.—Schematic diagram of normal liver structure. Blood from the portal vein and hepatic artery combines to bathe the liver cords and passes out through the central vein to the vena cava (adapted from Young,<sup>7</sup> after Rich)

or, better yet, by a blood bilirubin. The accepted top normal value for serum bilirubin varies from one institution to another but for a good working rule, any value above 0.5 mg. per 100 cc. is abnormal.

The next problem is to determine whether the jaundice is the result of excessive blood destruction or of disease within the liver. A fairly good definition of jaundice is that it is any elevation of blood bilirubin above the normal value. The blood bilirubin derives from the destruc-

## PRIMARY MALIGNANT TUMORS OF THE GALLBLADDER

*History.*—Although gallstones are present in 90 per cent of patients with malignant gallbladders, symptoms of cholelithiasis are often lacking. Warren and Balch found in 27 per cent of cases that symptoms had been present for less than a month, in 29 per cent for one to six months, and in 44 per cent they had been present for over six months. Symptoms referable to the carcinoma itself are insidious in onset. Steady pain and weight loss are the most typical. Jaundice occurs in more than one half.

*Physical Examination.*—Females are afflicted three times oftener than males. Although malignant tumors may occur at any age, there is a peak incidence between 50 and 55 years. A palpable mass or palpable liver is found in over half the cases. Distant metastases are rare.

*Laboratory Studies.*—Anemia is not necessarily present. The bilirubin will correspond to the degree of jaundice. Biliary drainage may reveal some erythrocytes and is thus helpful if trauma from the passage of the tube can be ruled out.

*Röntgen Examination.*—The gallbladder is rarely seen by cholecystogram. A barium meal will be helpful only late in the disease when adjacent structures are involved.

## TORSION OF THE GALLBLADDER

This is a rare condition dependent upon complete investment of the gallbladder by peritoneum and suspension by the cystic duct alone. It is most common in elderly women who may or may not have had chronic dyspeptic symptoms.<sup>1</sup> The attack is ushered in by pain in the right upper quadrant and vomiting. Physical examination will frequently show a palpable mass in the right upper quadrant of the abdomen. Rigidity and tenderness may mask it. Sudden increase or decrease in the size of such a mass is almost diagnostic. The pulse and temperature are typically normal for the first thirty-six hours. As the condition progresses to gangrene and perforation, the signs become those of acute cholecystitis. There is no jaundice. The cholecystogram will show no visualization of the gallbladder although the diagnosis should preferably be made without this aid, especially if the patient is critically ill.

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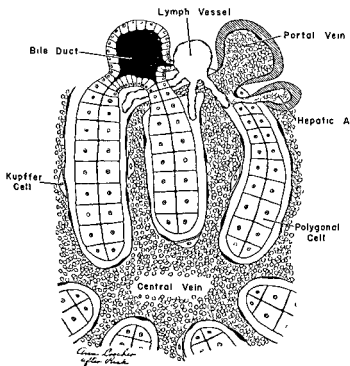


Fig 162.—Schematic diagram of normal liver structure. Blood from the portal vein and hepatic artery combines to bathe the liver cords and passes out through the central vein to the vena cava (adapted from Young,<sup>7</sup> after Rich.)

or, better yet, by a blood bilirubin. The accepted top normal value for serum bilirubin varies from one institution to another but for a good working rule, any value above 0.5 mg. per 100 cc. is abnormal.

The next problem is to determine whether the jaundice is the result of excessive blood destruction or of disease within the liver. A fairly good definition of jaundice is that it is any elevation of blood bilirubin above the normal value. The blood bilirubin derives from the destruc-

tion of worn out or fragmented red cells. The iron portion of hemoglobin is split off, leaving a molecule called bilirubinglobin. It is the job of the liver to remove from the blood and to excrete in the bile this bilirubinglobin. After passing through the polygonal cells of the liver, bilirubinglobin becomes sodium bilirubinate.<sup>4</sup> Since new red

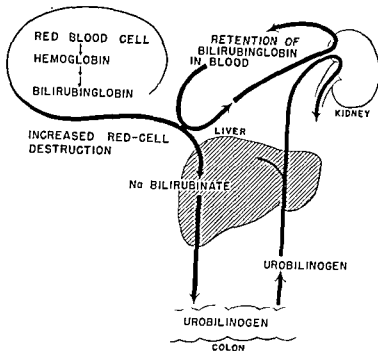


Fig 163.—Hemolytic jaundice, the result of increased red cell destruction, results in increased amounts of bilirubinglobin in the blood. The liver cells cannot eliminate all this excess, but bilirubinglobin cannot pass the renal threshold, therefore does not appear in the urine. Increased urobilinogen appears in feces and urine. (Modified from Young<sup>7</sup> and Rich)

cells are normally formed at about the rate of 10,000,000 cells per second,<sup>1</sup> the same number must be destroyed or eliminated from the circulation. A diagrammatic scheme of the liver pattern is shown in Figure 162. If the rate of destruction by any agent, whether known or idiopathic, exceeds the capacity of the liver to eliminate bilirubin, jaundice must follow. If the destroying agent is outside the liver and bilirubin rises, jaundice is said to be hemolytic. The acute type may follow or accompany any acute blood destroying disease or condition as, for instance, in malaria, scarlet fever, yellow fever, transfusion reactions, and so forth. The chronic type of hemolytic jaundice is said

to be acquired if it follows as a consequence of any known acute cause but fails to clear up or recurs at intervals. The familial hemolytic icterus is just what its name implies, a familial trait, characterized by exacerbations and remissions of jaundice due to excessive blood destruction, associated with chills, fever, an enlarged spleen, and increased fragility of the red blood corpuscles.

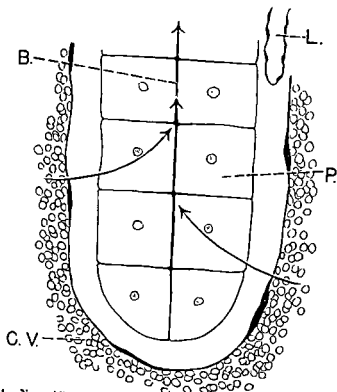


Fig 16L.—Normal liver *P*, polygonal cell; *B*, bile canaliculus; *C.V.*, central vein of liver. (After Young ?)

The differentiation of hemolytic jaundice from hepatogenous jaundice is not difficult. The finding of a known toxic agent, the presence of an increased amount of bile and of urobilinogen in the stools and of an increased amount of urobilinogen in the urine plus the absence of bile in the urine, together with normal liver function tests, will usually make the condition clear.

The reason given for this acholuric jaundice is that the bilirubin is still in the form of bilirubinglobin, not having passed through the liver cells; the kidneys have a high threshold for bilirubinglobin but

not for sodium bilirubinate.<sup>7</sup> Therefore, there is no bile in the urine (Fig. 163).

### RETENTION JAUNDICE

The type of jaundice described by Rich and by Young as retention jaundice includes hemolytic jaundice and minor degrees of subnormal

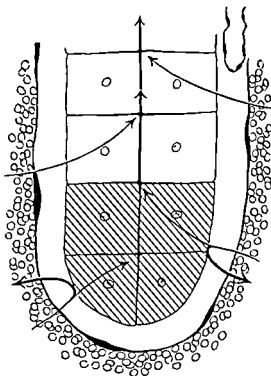


Fig. 165.—Mechanism in retention jaundice. Normal polygonal cells, shown above, convert bilirubinglobin to sodium bilirubinate. Partly damaged liver cells will pass only a small amount of bilirubinglobin, the greater part remaining in the blood. (Modified from Young,<sup>7</sup> after Rich)

function of the liver cells. This failure of cellular function may be caused by anoxemia, as in heart failure pulmonary infarction and pneumonia. It may be due to toxic products in the blood, or to actual poisons of a chemical nature. The mechanism of normal liver function is shown in Figure 161. The mechanism of retention jaundice is illustrated in Figure 165.

## REGURGITATION JAUNDICE

According to Rich and to Young, bilirubin exists in the blood as bilirubinglobin, which must pass through the polygonal cells of the liver to become sodium bilirubinate for excretion in the bile. If the

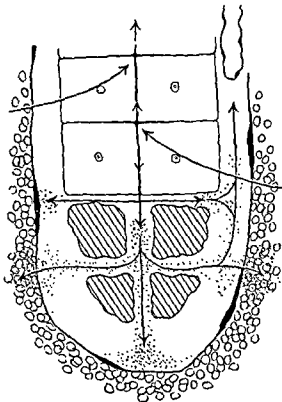


Fig 166 —Mechanism in regurgitation jaundice due to severe hepatitis. Some liver cells are intact and bile passes through the normal route. Other cells are badly damaged, functionless, and allow bile to pass back around them to the lymph spaces and to the central vein. (After Young.)

liver cells are badly damaged by disease, such as yellow fever, malaria, infectious hepatitis, much of the sodium bilirubinate formed in the polygonal cells leaks out around the damaged cells, regurgitating into the lymph spaces and into the sinuses leading to the central veins and eventually the vena cava. This means that the blood bilirubin level will rise (Fig. 166).

Obstructive jaundice, as contrasted to hepatocellular jaundice mentioned above, is caused by some block in the biliary system. In the beginning the individual liver cells are intact but the bile regur-



gitates past these cells into the lymph and blood spaces. For a time the liver function is not affected and the function tests are normal except the excretory tests. If the obstruction is of long standing, the polygonal cells of the liver become damaged because of interference

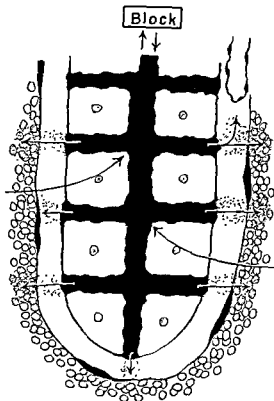


Fig. 167 —Mechanism in regurgitation jaundice due to obstruction. The liver cells are intact and functioning but back pressure of the secreted bile causes a rupture of the canaliculi and regurgitation into the blood stream (After Young '1)

with blood supply, because of back pressure of the bile and because they are bathed in too high a concentration of bilirubin. This leads to the clinical state of biliary cirrhosis with jaundice as its chief feature. In addition to the jaundice, all the tests of liver function show greater or lesser degrees of impairment (Fig. 167).

Jaundice caused by cholangitis probably belongs in the regurgitation jaundice group. Young's explanation of how it occurs is logical and his drawing, adapted from Watson, is shown in Figure 168.

In regurgitation jaundice bile salts as well as bilirubin pass back into the blood stream. It is these bile salts which are thought to cause the

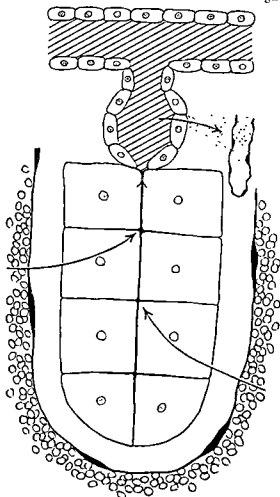


Fig. 163 — Mechanism of regurgitation jaundice in cholangitis. The liver cells are normal but bile escapes into the lymph and blood spaces through dilated bile capillaries or larger biliary radicles. (After Young,<sup>7</sup> modified from Watson.)

itching so annoyingly present in obstructive jaundice and notably absent in hemolytic or retention jaundice.

#### DIFFERENTIAL DIAGNOSIS

In order to form an opinion about any given type of jaundice, some knowledge of the various liver function tests and their limited scope is

desirable. A list of some of the known liver functions is shown in Table 1.

TABLE 1  
LIVER FUNCTIONS

<i>Carbohydrate metabolism</i>
<i>Protein metabolism</i>
<i>Fat metabolism</i>
<i>Production of serum colloids and electrolytes</i>
<i>Excretory functions</i>
<i>Detoxication</i>
<i>Prothrombin production</i>
<i>Fibrinogen production</i>
<i>Reticulo-endothelial activity</i>
<i>Production of vitamin A from carotene</i>
<i>Heparin production</i>

Not all of these functions can be accurately tested. It is well known that there is no liver function test or group of tests that completely delineates the functions of a liver. It is equally well known that the functions of the liver, being so varied, can change from day to day. The best we can hope to do is approximate the function and the trend of the liver toward improvement or deterioration.

The tests which can be applied are many and the functions they attempt to measure are diverse, but experience has shown the value of a few and the unreliability of others. We shall mention here only those which seem to have proved most helpful.

The serum bilirubin determination is probably the most useful liver function test. The "one minute bilirubin"<sup>2</sup> is said to measure the sodium bilirubinate present (the direct reaction), while the total bilirubin is an index of the sodium bilirubinate plus the bilirubinglobin in the blood. Thus, the one minute bilirubin will be low or absent in hemolytic or retention jaundice because most of the bilirubin present is in the form of bilirubinglobin. In severe hepatocellular jaundice or in obstructive jaundice the direct or one minute reading will be high, comprising most of the total.

The bromsulfalein test is a test of the excretory function only. It should be high in all types of jaundice except hemolytic and the milder forms of retention jaundice. A dose of 5 mg. per kilogram is preferable and a single blood specimen is taken forty-five minutes after the dye is given. Any dye remaining at this time indicates liver damage.

While the glycogenic function or carbohydrate metabolism is one of the most vital of the liver functions, the tests of this function are unsatisfactory. Neither the glucose tolerance nor the galactose tolerance has proved of any decisive value.

Determination of the serum protein and of the albumin-globulin ratio gives some idea of the protein metabolism; in cases of liver damage, the albumin-globulin ratio may be reversed, but the exact

significance of this is not well understood. If the reversal of this ratio persists, it is a bad prognostic sign.

The urobilinogen determinations<sup>6</sup> are important, helpful in differentiation and not difficult. Urobilinogen is formed almost exclusively in the intestine from bile reaching the intestine by way of the common bile duct. This intestinal urobilinogen is partly reabsorbed by the portal circulation, returned to the liver and used by it in protein synthesis. If the liver is damaged, much of the urobilinogen is passed

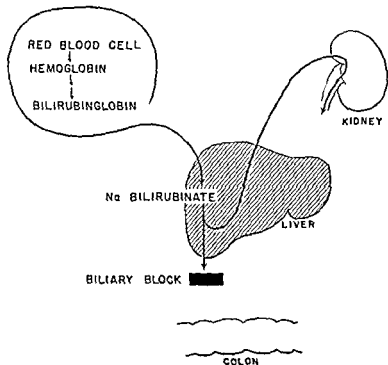


Fig. 169—Mechanism of obstructive jaundice with absence of fecal and urinary urobilinogen.

on to the kidney where it is excreted. Hence, an increase in fecal urobilinogen occurs in hemolytic jaundice; an increase in urine urobilinogen occurs in most cases of liver damage and particularly in portal cirrhosis; no urobilinogen will be found in the feces or urine if obstructive jaundice is present (Fig. 169).

The tests based on serum colloids and electrolytes are not yet well understood. There has been a great deal written about the application and comparative value of the Takata-Ara test, the cephalin-cholesterol flocculation test, the thymol turbidity test, the thymol flocculation test and the colloidal gold test.<sup>7</sup> No one as yet has satisfactorily

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Not all of these functions can be accurately tested. It is well known that there is no liver function test or group of tests that completely delineates the functions of a liver. It is equally well known that the functions of the liver, being so varied, can change from day to day. The best we can hope to do is approximate the function and the trend of the liver toward improvement or deterioration.

The tests which can be applied are many and the functions they attempt to measure are diverse, but experience has shown the value of a few and the unreliability of others. We shall mention here only those which seem to have proved most helpful.

The serum bilirubin determination is probably the most useful liver function test. The "one minute bilirubin"<sup>2</sup> is said to measure the sodium bilirubinate present (the direct reaction), while the total bilirubin is an index of the sodium bilirubinate plus the bilirubinglobin in the blood. Thus, the one minute bilirubin will be low or absent in hemolytic or retention jaundice because most of the bilirubin present is in the form of bilirubinglobin. In severe hepatocellular jaundice or in obstructive jaundice the direct or one minute reading will be high, comprising most of the total.

The bromsulfalein test is a test of the excretory function only. It should be high in all types of jaundice except hemolytic and the milder forms of retention jaundice. A dose of 5 mg. per kilogram is preferable and a single blood specimen is taken forty-five minutes after the dye is given. Any dye remaining at this time indicates liver damage.

While the glycogenic function or carbohydrate metabolism is one of the most vital of the liver functions, the tests of this function are unsatisfactory. Neither the glucose tolerance nor the galactose tolerance has proved of any decisive value.

Determination of the serum protein and of the albumin-globulin ratio gives some idea of the protein metabolism; in cases of liver damage, the albumin-globulin ratio may be reversed, but the exact

The serum cholesterol, combined with a cholesterol ester determination, is sometimes of definite value. In obstructive jaundice, the total cholesterol is increased. In hepatocellular jaundice, first the esters and later the total cholesterol may be much decreased. In fatal cases they will fall almost to the zero point.

### SUMMARY

In a particular case of jaundice, the differentiation as to the type will usually be obvious from the history alone. A carefully taken history will prove more rewarding than many tests. In those cases in which the cause of icterus is not definite, the use of a table similar to Table 2 will be helpful.

There will be rare occasions when it will be impossible to decide whether or not a particular case of jaundice has enough features of obstruction to make it a surgical problem. In such cases it is better to operate than to temporize. It will usually be discovered that a combined form of jaundice exists; for example, an obstructive jaundice, such as one caused by a stricture of the common bile duct, may be combined with an extensive degree of biliary cirrhosis.

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explained just what it is that these tests measure. On the other hand, everyone is agreed that they are very valuable tests, that they are among the most delicate and most reliable tests of liver dysfunction, and that no one of these tests covers all the various types of liver dysfunction. For that reason it is customary to order more than one, believing that if they are all normal, the chances are very good that the liver function is normal. They offer a valuable check on the progress of liver disease and their final return to normal is the best evidence we have that the pathologic process has finally subsided. They do not offer any differentiation between intrahepatic and obstructive jaundice but are likely to be normal in hemolytic jaundice. In early obstructive jaundice they will also be normal but will change quickly as damage to the liver occurs consequent to back pressure in the biliary tree.

TABLE 2

Test	Retention Jaundice		Regurgitation Jaundice	Normal Values
	Hemolytic Jaundice	Hepatocellular Jaundice	Obstructive Jaundice	
Bilirubin.	1 minute—(0.2) low Total—high 2 to 5 mg %	1 minute—(1) high Total—very high (over 15 mg %)	1 minute—high Total—high 7 to 10 mg %	1 minute—0 to 0.2 mg Total—0.1 to 0.5 mg.
Urobilinogen Feces...	High	Normal or low	Absent	2 to 4 gm. per day
Urine.	Slightly elevated	High	Absent	1 to 30 or less
Serum protein Albumin-globulin ratio.	Normal or low Normal	High Reversed	Normal Normal	6 to 7 gm % 3 to 4 gm % 1 to 3 gm %
Bromsulfalein, 5 mg per kilogram dose.	Normal	Dye retention	Dye retention	0% in 45 minutes
Cephalin flocculation.	Normal	Positive	Normal (Any of these can become abnormal after liver damage occurs)	0 to +
Thymol turbidity.....	Normal	Positive		0 to 3 units
Thymol flocculation ...	Normal	Positive		0 to +
Cholesterol ester.	Normal Normal	Normal or low Low	Elevated Normal	150 to 220 mg % 60% of total

## THE VALUE OF DUODENAL DRAINAGE: ITS PLACE IN DIAGNOSIS

S. ALLEN WILKINSON

DUODENAL drainage or biliary drainage has been well publicized in the past. It is now accepted as one of several methods of procedure in establishing a diagnosis of biliary tract and liver diseases, but in recent literature it has largely been neglected and, except in a few isolated spots, its use apparently has decreased in the last several years. There are several reasons for this, among which are the facts that it is time consuming, it is disliked by patients, it requires a good deal of cooperation on the part of the patient as well as an appreciable amount of the patient's time, it is difficult to interpret without some special training, and even in the best hands there are certain inaccuracies which are bound to occur. In addition, the procedure of duodenal drainage, particularly in the hands of thoughtless individuals, has been used and abused as a diagnostic method and as a method of therapy, resulting in the whole procedure acquiring a tinge of charlatanism.

Biliary drainage, however, still has its uses and, in the hands of those who are aware of its worth and who appreciate its limitations, it cannot be replaced by any other procedure. It is valuable enough to include in our diagnostic armamentarium and should be used strictly as a diagnostic procedure more often than it is.

### INDICATIONS FOR USE

Duodenal drainage may be used and should be used in those cases in which the diagnosis of gallbladder disease is in doubt and in which the Graham test does not help to establish a definite diagnosis. These cases are fewer than we might suspect. In practically all doubtful cases, a repetition of the Graham-Cole test after a period of a month or six weeks of strict dietary regulation will reveal either that the gallbladder functions well and is normal or that it does not function at all and is definitely abnormal. In such cases very little more can be gained by employing duodenal drainage. The procedure is of much more value in the diagnosis of common duct stone. In such cases there is nothing which can replace it. This is particularly true when the gallbladder has been removed and when recurrent attacks suggest the possibility of a common duct stone. It has been shown repeatedly that roentgenograms will not reveal common duct stones under such circumstances and the ordinary liver function tests give little or no information except that there may be some degree of liver damage. It is in these cases that duodenal drainage gives an accurate and usually a complete answer to the problem.

Verification of the diagnosis of cholangitis is another advantageous





and the total time taken until the tube passes into the duodenum is considerably reduced. Stimulation is made with 30 cc. of 50 per cent magnesium sulfate diluted to 100 cc. with warm water. This is introduced through the tube and is allowed to siphon back immediately and is not retained in the duodenum. Bile is collected in a specimen bottle and a second or third stimulation of magnesium sulfate is used if necessary. This bile is examined both grossly and microscopically and is not centrifuged.

### GROSS EXAMINATION

The bile should be inspected for color, clarity, turbidity, amount of precipitation or sediment, presence or absence of blood which can be seen grossly. In addition to these findings, the presence or absence of B bile and C bile should be noted. Since most of the duodenal drainages will be in cases in which the gallbladder has been removed, no B bile will be found, but in the cases in which the gallbladder is present, it is important to note whether there is a darker colored layer of bile, indicating a contraction of the gallbladder.

### MICROSCOPIC EXAMINATION

The microscopic examination of bile is not difficult, but if it is poorly done, very little will be learned from an examination no matter how well the examination may have been conducted. It is important to pick up with a pipet flecks which float in the bile or which may form sediment on the bottom of the specimen bottle. On examination there may be several different kinds of flecks found and each kind should be inspected microscopically. Some of these will undoubtedly turn out to be clumps of mucus from the stomach or clumps of epithelial cells and debris from the stomach or from the duodenum. A little experience enables the observer to recognize these immediately. Other clumps will be strands of mucus to which are adherent large clumps of precipitated bile salts. After the precipitated bile salts have been seen and recognized microscopically, they should not be confused with other biliary components. These bile salts are normal and will precipitate in the presence of an excess acid in the stomach. The finding of bile salts, therefore, has no particular significance.

The important microscopic constituents of bile from a diagnostic standpoint are the presence or absence of bile-stained pus cells and some estimation as to the total quantity of pus cells present; the presence of columnar bile-stained epithelial cells, indicating exfoliation from the biliary tract; the presence of clumps of bile-stained bacteria; the presence or absence of calcium bilirubin pigment; the presence or absence of cholesterol crystals. In addition to these findings, one may find motile *Giardia lamblia* which may inhabit the upper duodenum. Also intestinal parasites, such as hookworm or *Strongyloides* in motile form, may occasionally be seen.

use of duodenal drainage. In such cases the finding of bile-stained bacteria, large clumps of bile-stained pus cells and the typical bile-stained tall columnar epithelial cells lining the biliary tract gives evidence of a rather widespread inflammatory or infectious process involving the biliary tree. Another use for the procedure is to determine the presence or absence of bile in the duodenum in cases of suspected obstruction in which jaundice is present. If it can be accurately determined that the tip of the tube is in the duodenum and if no bile be obtained by drainage, it is reasonably fair to assume that some obstruction is the cause of the jaundice. It must be remembered, however, that in early cases of acute severe hepatitis, little or no bile will pass the sphincter of Oddi. A final use and an important one is to help in the decision for or against malignancy as a cause of obstructive jaundice. In many cases of malignancy involving the head of the pancreas, the ampulla of Vater or the biliary tree, the finding of gross blood in the duodenal contents when a drainage is attempted will establish the diagnosis, although failure to find gross blood in the duodenal content does not rule out the possibility of a malignant lesion.

### CONTRAINDICATIONS

When the diagnosis is already established by other procedures, the addition of duodenal drainage probably gives no additional information and certainly puts the patient to a considerable degree of inconvenience and expense. When the patient is too weak or too ill to undergo the procedure, it obviously should not be attempted. In those cases in which operation will be done regardless of the result of the drainage and when the information that can be gained will not change the probability of an operation, it seems rather fruitless to go ahead with such a procedure.

### METHODS

The method of duodenal drainage has been adequately described many times and is now found in all textbooks. There are a number of substances which may be used for stimulating the flow of bile.

The method which we use and prefer is to pass the Rehfuess tube through the mouth and have the patient swallow until the tip of the tube just reaches the cardiac end of the stomach. This is usually the first mark on the Rehfuess tube. The patient should then be turned on the right side and instructed to swallow the tube slowly over a twenty-minute period to the third mark. Formerly it was our custom to pass the tube to the second mark, introducing the tip of the tube to the middle of the stomach and then to turn the patient on the right side. By changing the procedure to swallow only to the first mark, we find that the tube passes along the *magenstrasse* of the stomach to the pylorus very quickly. There is much less tendency to curl in the stomach

ment is present, but there are no crystals, stones are present in more than 90 per cent of the cases. When both crystals and pigments are present, stones are found in about 96 per cent of the cases.

### RESULTS

In the past fifteen years there have been somewhat more than 1,000 duodenal drainages done at the Lahey Clinic. Most of these were done in cases of suspected common duct stone or when it was necessary to rule out the probable diagnosis of common duct stones. For that reason many of these patients were not operated on and therefore the accuracy of the interpretation cannot be verified. On the other hand, the follow-up on these cases indicates the probable accuracy in most cases and the following figures from 1,000 cases of duodenal drainage indicate the result. A normal biliary tract was found in 531 cases. There was evidence of biliary tract infection, but not of stones, in an additional 226 cases. Common duct stone was diagnosed 237 times and malignancy was diagnosed 6 times. In those cases which could be verified by operation, the accuracy of the procedure of duodenal drainage was 91 per cent. In many of the cases quoted above operation was not carried out because the drainage and the other findings indicated that the patient had a normal biliary tract or else that the jaundice which was being investigated was of a nonsurgical nature and not one which would require operation.

### CONCLUSION

Duodenal drainage as a diagnostic procedure is time consuming, rather difficult for the patient and requires a good deal of the physician's personal attention. In exchange for this an amount of information is gained which makes this a valuable procedure and not one to be discarded lightly. Its proper use has saved a good many patients with questionable disease of the biliary tract from operation and has enabled us to verify the diagnosis of stones, indicating the need for further operation in many other cases. Its virtues when adequately appreciated outweigh its disadvantages sufficiently so that duodenal drainage should be used as a valuable adjunct to the diagnosis of biliary tract disease.

## INTERPRETATION

The finding of a clear or slightly turbid mahogany or a dark brown bile indicates a normally functioning gallbladder. The finding of clear yellow bile or slightly turbid yellow bile indicates an actively functioning liver and if the bile is crystal clear, it usually indicates a normal liver. As explained above, the turbidity due to precipitation of bile salts by the gastric acid is not an abnormal finding. The bile salts present a microscopic appearance of a rather homogeneous deposit of lemon yellow granules somewhat smaller than red blood cells, usually attached or grouped around long strands of mucus.

Large clumps of bile-stained pus cells and bile-stained bacteria may appear and often do appear in acute and in chronic hepatitis. In the very acute phase, the secretory action of the liver is so greatly reduced that no bile may appear, but in later phases of the disease some bile can always be obtained. Bile-stained columnar epithelium usually indicates some disease or infection of the biliary tree and is present rather constantly in cholangitis of varied grades. The presence of the pus cells mentioned above and of the epithelial cells is conclusive evidence that an infectious process is going on. It is important to remember that these cells should be deeply bile-stained. Pus cells which are not bile-stained do not originate in the biliary tract even though they may be found in the bile. The same is true of epithelial cells, although columnar epithelial cells are found only in the biliary tree.

The presence of clumps of gross blood or strands of bloody mucus throughout the drainage almost always indicates malignancy. An occasional small blood fleck may be seen in any bile, but the presence of an obvious amount of blood is not a normal finding. This, of course, must exclude the possibility of a duodenal ulcer which might be bleeding, but it is assumed that ulcer has been ruled out by previous studies.

Cholesterin crystals and calcium bilirubin pigment almost always indicate the presence of stones, either in the gallbladder or in the common bile duct. It is true that occasionally cholesterin crystals can be found in certain cases of biliary tract disease, particularly hepatitis, and they will often be found in bile subsequent to an operation when the common bile duct has been opened and drained. Examination of the bile collected from the T tube for perhaps a week or ten days subsequent to removal of stones from the common duct will show the persistence of cholesterin crystals and of calcium bilirubin pigment in the bile even though stones are not present. When bile salts begin to appear in the bile again, the cholesterin crystals promptly disappear. The presence of calcium bilirubin pigment, which can always be recognized after it has once been seen because of its clear golden yellow color, again is almost pathognomonic of stones. When crystals alone are present in the bile and there is no evidence of any calcium bilirubin pigment, stones are present in about 80 per cent of cases. When pig-

## LABORATORY AIDS IN THE DIAGNOSIS OF LIVER DISEASE

JOHN W. NORCROSS AND ROBERT F. BRADLEY

IN the practice of modern medicine the study of diseases of the liver, in both their medical and surgical aspects, is taking a more important place than ever before. Much progress has been made in recent years in the development of laboratory methods to detect low grade impairment of hepatic function and to help distinguish between the jaundice of conditions that are purely medical and those that require surgery.

It is the purpose of this paper to discuss the value and limitations of the older procedures and of some of the newer laboratory aids as they have been applied at the Lahey Clinic. Early, accurate diagnosis becomes of greater value with our present-day understanding of liver abnormalities and improved treatment of liver disease.

Our knowledge of the liver as an organ with numerous functions, some known and others as yet only suspected or partially understood, makes it obvious that no single test can be expected to give all the required information in the study of disease of the hepatic and biliary tracts. There are some functions for which no diagnostic test is known and the specificity of even the most reliable tests is at times questionable.

The laboratory aids will be discussed under two groupings: the first, those procedures used routinely, and the second, those procedures of value under special circumstances.

### PROCEDURES USED ROUTINELY

**Bromsulfalein Test.**—This test was introduced in 1925 by Rosenthal and White. The dosage used is 5 mg. of dye per kilogram of body weight, and a single blood specimen is taken at the end of forty minutes. In this way, the ability of the liver to remove a foreign dye material from the blood stream and excrete it can be measured. In a series of normal controls, the normal values have been found to be from 0 to 5 per cent retention at the end of forty minutes. Reactions to bromsulfalein are rare and with few exceptions are mild.

In a large series of patients with liver disease of all types this test is unusually reliable in the absence of jaundice and has been shown to be at least as sensitive as any other single test of liver function. It is contraindicated in those patients who are suspected of having obstructive jaundice because of the long period of time over which extremely high blood levels may be maintained and the inaccuracy of retentions directly attributable to mechanical obstruction in these patients. The value of this procedure in patients whose jaundice is on the basis of a



TABLE 2  
LABORATORY PROCEDURES USED ROUTINELY IN THE STUDY OF PATIENTS WITH  
LIVER DISEASE

Test	Normal Value
Bromsulfalein . . . . .	0-5 per cent retention at end of 10 minutes
Cephalin-cholesterol flocculation	0 to 1+ (at 48 hours)
Thymol turbidity . . . . .	0 to 3.0 units
Thymol flocculation	0 to 1+
Serum bilirubin	0 to 0.2 mg. per 100 cc.—1 minute prompt direct
	0.1 to 1.0 mg. per 100 cc.—total
Urine bilirubin	0 to 0.25 mg. per 100 cc.
Urine urobilinogen	1.0 Ehrlich units (2 to 4 p. m. specimen)
Cholesterol, total	110 to 250 mg. per 100 cc.
Cholesterol esters . . . . .	60 to 75 per cent of total
Alkaline phosphatase	1.5 to 4.0 Bodansky units
Serum protein	
Total	6.5 to 8.0 gm. per 100 cc.
Albumin	4.0 to 5.5 gm. per 100 cc.
Globulin	1.5 to 3.0 gm. per 100 cc.

**Cephalin-Cholesterol Flocculation Test.**—The Hanger cephalin-cholesterol-flocculation test was described in 1938 and 1939,<sup>2,3</sup> and has been modified to increase its reliability. This test measures the function of the hepatic parenchymal cells in their ability to produce normal serum protein components. When these cells are damaged, an increased amount of gamma globulin may be produced, while normal serum albumin is formed in decreased quantity. This change in the serum proteins causes a flocculation of the cephalin-cholesterol emulsion in the presence of physiologic saline solution.

In the first few years of its use, the test was subject to the serious error of giving many false positive reactions. At present these errors have been almost entirely eliminated by a number of important modifications. The most important of these are:

1. The use of ripened cephalin-cholesterol antigen. The Difco product has been most uniformly satisfactory. A fresh emulsion must be prepared daily.
2. The serum plus emulsion plus saline mixture must be kept in the dark for the entire forty-eight hour period because of the proven photosensitivity of the reaction.
3. The test should be set up promptly so that the serum is not allowed to stand more than five hours in the light at room temperature. The cephalin-cholesterol emulsion must be added promptly after the saline has been added to the serum. Freshly drawn serum may be kept in the dark at from 0 to 5° C. (32° to 40° F.) without harm for twenty-four hours if set up promptly on removal to room temperature.



diffuse parenchymal damage is debatable, but we believe that serial tests at regular intervals may be an additional aid in evaluating the progress of hepatic function in such cases.

It is important to remember that this test, despite its high sensitivity, will not necessarily be positive in every given case of liver disease. Rather marked impairment, as shown by other tests, may be accompanied by a completely normal bromsulfalein value.

From a surgical standpoint little may be gained by the use of the bromsulfalein test to decide whether a jaundiced patient is a surgical problem. Its chief value to the surgeon is in the nonjaundiced patient in whom serious liver damage may permanently contraindicate an operative procedure or at least require intensive medical therapy first. In our experience the liver damage associated with gallbladder disease will cause an increased retention of bromsulfalein nearly twice as often as will be true with any other single liver function test. A similar observation has been made by Mateer.

TABLE I

LABORATORY FINDINGS IN CASES OF OBSTRUCTIVE JAUNDICE AS COMPARED TO HEPATOCELLULAR JAUNDICE

Test	Uncomplicated Obstructive Jaundice	Hepatocellular Jaundice
Bromsulfalein.	Not used	Increased retention
Cephalin-cholesterol flocculation.	Usually 0 to 1+; not over 2+	2+ or more
Thymol turbidity	Negative	Over 30 units
Thymol flocculation	Not over 1+	Over 1+
Bilirubin		
1 minute prompt (direct)	Increased early	Increased late (frequently)
Indirect type	Increased late	Increased early
Urine bilirubin	Increased	Increased
Urine urobilinogen	Markedly decreased in complete obstruction	Increased
Cholesterol:		
Total	Increased	Decreased if damage severe
Esters.	Increased	Decreased if damage severe
Alkaline phosphatase	Increased	Decreased if damage severe
Serum protein.	Unchanged	Albumin decreased if damage severe
Stool urobilin	Decreased	Unchanged except in obstructive phase

The thymol turbidity test has a sensitivity about 50 per cent that of the bromsulfalein or cephalin-cholesterol flocculation tests in a large series of all types of liver disease. Its chief value accrues from the uniformly negative results seen in patients with jaundice due to extrahepatic biliary obstruction compared to elevated values seen in hepatocellular jaundice. The quantitative results in units give some index of the degree of parenchymal cell damage.

During the convalescent phases of infectious hepatitis the thymol flocculation and thymol turbidity tests are positive much longer than other liver function tests, making them of real value in detecting low-grade residuals of an acute hepatitis.<sup>7</sup>

**Thymol Flocculation Test.**—This test is a continuation of the thymol turbidity procedure in that the reagents and serum used for the turbidity test are allowed to stand for eighteen to twenty-four hours and then the flocculation is read from 0 to 4 plus. Any value above 1 plus is considered abnormal. When jaundice is present the sensitivity of the thymol flocculation follows the same pattern outlined for the thymol turbidity test. In patients without jaundice, however, the sensitivity is considerably greater than with the thymol turbidity and approaches that of the cephalin flocculation and the bromsulfalein tests. It is an excellent check on the very sensitive cephalin-cholesterol flocculation procedure, although a negative value in the presence of a positive Hanger test does not necessarily mean that the latter is incorrect. For instance, in early hepatitis or cirrhosis, the cephalin-cholesterol flocculation test is often the only positive test. Conversely, in convalescent hepatitis when the bilirubin metabolism has become normal, the thymol turbidity and thymol flocculation may remain positive for a considerable period after all other liver function tests are normal.

**Serum Bilirubin Test.**—Degrees of jaundice, whether clinical or subclinical, are best measured by a method giving a prompt, direct reacting bilirubin (one minute) and a total bilirubin. We have used the method of Malloy and Evelyn with the modification of Ducci and Watson. The normal values for prompt, one-minute bilirubin are from 0 to 0.2 mg. per 100 cc. and the normal values for the total bilirubin range between 0.1 and 1.0 mg. per 100 cc. It should be emphasized that values between 0.5 and 1.0 mg. per 100 cc. occur in only a small percentage of normals.

Levels of hyperbilirubinemia required to produce clinical jaundice vary considerably. Subclinical jaundice occurs frequently and no study of liver function may be called normal unless both the prompt direct and total values are found to be within normal limits. Results of bilirubin determinations in obstructive jaundice give early increases in direct reacting bilirubin so that the total may also be elevated and later an attendant increase in indirect reacting bilirubin as well, at which time the total bilirubin will be distinctly higher. Hepatocellular jaundice is associated with a rather marked early rise in the indirect

4. False positive results occur at elevated temperatures. The percentage of these increases rapidly as temperatures rise above 27° C. (80° F.) This means that during the summer incubation must be carried out at temperatures below this level.

We have adhered closely to these modifications and readings are made at forty-eight hours. Any reading greater than 1 plus is considered abnormal.

If a large series of patients with many types of liver disease is considered, the cephalin-cholesterol flocculation test is approximately as sensitive as the bromsulfalein test in the detection of impairment of liver function. It is entirely unaffected by jaundice.

Perhaps the single greatest value of the procedure lies in the differentiation of jaundice associated with diffuse parenchymal disease from jaundice secondary to extrahepatic biliary obstruction. In the former type of case, 3 or 4 plus reactions are the rule whereas in the latter the results are usually normal unless the obstruction is accompanied by biliary tract infection. Common duct strictures or common duct stones with cholangitis often give positive reactions. In our own experience, long-standing obstructive jaundice without infection usually does not give more than a 2 plus value.

This test may have prognostic significance in some cases. Particularly is this true in portal cirrhosis where a persistently 4 plus reaction is frequently associated with early decompensation and a steady downhill course. As a general screening test for liver disease, the modified Hanger procedure is unsurpassed because of its sensitivity, reliability and simplicity. The surgeon will find it of value because it may bring to light an otherwise unsuspected hepatic damage which should be treated before operation is performed. In general, the Hanger test detects liver function impairment associated with gall-bladder disease with a sensitivity second only to the bromsulfalein test and gives about 50 per cent as many positive results. It must be emphasized that positive readings with different liver function tests frequently do not occur in the same patient so that one procedure cannot be used to the exclusion of another.

**Thymol Turbidity Test.**—The thymol turbidity test was first described in 1941 by Maclagen. It is another flocculation type of procedure and reflects the functional ability of the hepatic parenchymal cells to produce normal serum protein fractions. High turbidities occur when there are increased serum levels of beta globulin and gamma globulin or some change in serum related to the combination of beta globulin with phospholipid.

Readings above 3.0 units are considered definitely abnormal. False positive results are very rare, and the test is unhampered by jaundice or hemolysis. Occasionally, erroneous results will be obtained in this test when the serum used is cloudy before the test is started. In such cases, clear serum should be obtained from the patient and the test repeated.

difficulty with this procedure is found in the time of excretion demanded by the method. Most people, however, eliminate urobilinogen in largest amounts in the middle of the day so that any grossly elevated excretion is significant regardless of collection time, and borderline values can be rechecked using the specified hours.

Patients with clinical jaundice who excrete very low amounts or no urobilinogen in the urine and in whom no external bile fistula is present probably have complete or nearly complete exclusion of bilirubin from the intestine and malignancy should be suspected. If the thymol turbidity, thymol flocculation and cephalin-cholesterol flocculation tests are markedly positive, then a low excretion of urobilinogen in the urine represents hepatocellular damage at the stage where maximal obstruction to the outflow of bile exists. In these cases, the reappearance of urobilinogen in the urine, usually in elevated amounts, suggests that the obstruction has been released. As recovery proceeds the excretion of urobilinogen should gradually return to normal. Persisting increased amounts in the urine signify incomplete or delayed healing of the hepatic parenchymal cells. In our experience, many patients with carcinomatous obstruction to biliary outflow excrete normal amounts of urobilinogen in the urine because the obstruction is not complete.

Excessive urobilinuria indicates that hepatic function is impaired or that there is excessive hemolysis and, therefore, an increased production of bilirubin. Urobilinogen excretion is elevated in the early and late stages of jaundice due to hepatic cell disease, whether due to infection or chemical poison, and it is frequently elevated in portal cirrhosis, chronic hepatitis and other liver disease not associated with jaundice.

**Cholesterol and Cholesterol Esters.**—Cholesterol esters are the chief factor in determining the rise and fall of the total cholesterol value and, therefore, have been determined in the study of patients with hepatic and biliary tract disease. We have accepted normal values of 140 to 250 mg. per 100 cc. for total cholesterol, of which 60 to 75 per cent is due to cholesterol esters.

In general, obstructive jaundice is associated with elevated total plasma cholesterol and ester levels. These values usually parallel the degree of hyperbilirubinemia. Parenchymal liver disease frequently gives total cholesterol and ester results that are normal or subnormal, and severe parenchymal liver disease usually leads to decreased values. When jaundice of short duration is seen with a distinctly low cholesterol ester value, diffuse liver disease of the parenchymal type should be suspected. In cases of long-standing obstructive jaundice, particularly of the common duct stricture type in which infection is often superimposed, repeated plasma cholesterol and ester determinations may be of help, for when these values begin to fall without relief of obstruction, an impairment of hepatic function due to a superimposed hepatitis has occurred. Elevated cholesterol values are seen frequently

type of bilirubin, but by the time jaundice is clinically evident the one minute bilirubin is usually also elevated. It is, therefore, obvious that bilirubin results are not of great value in determining which type of jaundice is present and whether or not the patient is a surgical problem. However, those cases in which the total bilirubin is moderately raised or very high, with a normal or only slightly elevated direct bilirubin, should suggest the possibility of a hemolytic jaundice. The greatest usefulness of the serum bilirubin determination is in following the progress of a patient's jaundice and is the only way of knowing when subclinical grades of icterus are gone. Persistently elevated direct bilirubin indicates that some regurgitation is still taking place, whether from mild obstruction or residual damage to hepatic cells lining the bile canaliculi.

**Urinary Bilirubin Test.**—While it is believed that no renal threshold exists for bilirubin, under normal circumstances the urine contains no more than a trace of this substance. With the highly sensitive test now available, it is possible to detect small amounts of *bilirubinuria*. We have used the modified Harrison spot test and the semiquantitative measurement of bilirubin as described by Watson and Hawkinson.<sup>9</sup> One outstanding merit of the test is its great sensitivity in early infectious hepatitis in which *bilirubinuria* is noted before clinical icterus appears. There is no adequate explanation for this early appearance of bilirubin in the urine in this disease.

**Urobilinogen in the Urine.**—Urobilinogen is formed from bilirubin by bacterial reduction in the intestine. This pigment product is then chiefly eliminated in the feces but a fraction is reabsorbed into the portal circulation and either taken up by the systemic circulation or reconverted by the liver into bilirubin. The portion appearing in the systemic circulation becomes available for elimination as urine urobilinogen and its quantitative level in the urine depends under ordinary circumstances upon liver function. When the liver is functioning normally and when the production of bilirubin is normal, only a very small amount of urobilinogen is left for excretion by the kidney. Complete absence of urobilinogen in the urine strongly suggests that complete biliary obstruction exists as may occur with carcinoma obstructing the biliary tract. This may also occur in the stage of severe infectious hepatitis in which the bile canaliculi have been plugged by cellular debris and edema.

The determination of urobilinogen by the simple quantitative Ehrlich reaction, as described by Watson,<sup>10 11</sup> has been used, a single two-hour specimen of urine being taken between 2 and 4 p.m. Normal values have been considered up to 1.0 Ehrlich units which corresponds to 0.25 mg. of urobilinogen in this two-hour specimen. Any single value greater than 2.0 units is distinctly abnormal with the rare exceptions of patients whose urines give a *falsely high Ehrlich reaction* because of high levels of bilirubin or because of elevated amounts of albumin. One

structive jaundice is present the prothrombin time is prolonged because of the exclusion of bile from the intestine and the consequent failure of the absorption of fat-soluble vitamin K. In such cases parenteral administration of vitamin K will be followed in a few hours by a return of the prothrombin value to normal, unless there is severe parenchymal liver damage. When hepatocellular damage is severe, with or without jaundice, the prolonged prothrombin time will be refractory to vitamin K therapy. This test of liver function has little sensitivity, as the failure to respond occurs only in the presence of very severe liver damage. Such a sign, however, has real prognostic value and when surgery is contemplated, a failure of the prothrombin time to return to normal after the administration of therapeutic doses of vitamin K parenterally should bring to the surgeon's attention the strong possibility of complete hepatic failure with hemorrhage postoperatively.

**Hippuric Acid.**—Under ideal conditions the measurement of the ability of the liver to conjugate sodium benzoate with glycine and form hippuric acid is an excellent test of the liver's detoxifying and conjugating function when the intravenous method is used. This test may approximately equal the sensitivity of bromsulfalein and the cephalin-cholesterol flocculation tests in a large group of patients. At the present time we rarely use this test because it is dependent on normal kidney function and complete emptying of the bladder, thus requiring catheterization in many cases. Because of the solubility of hippuric acid the technical laboratory procedure requires a limited amount of urine only, making any loss of the concentrated urine more important than would otherwise be the case.

**Tyrosinuria.**—Tyrosine crystals appear in the urine when very severe damage to the liver parenchyma occurs. This is of little value in the early diagnosis of liver disease, but is an indication, when present, of a poor prognosis because of rapidly advancing severe hepatocellular disease. As much as 2.0 gm. of tyrosine crystals may be excreted daily in cases of rapidly progressive acute yellow atrophy. Sometimes in the terminal stages tyrosine crystals may not be excreted so that absence of tyrosinuria does not necessarily mean an optimistic prognosis.

**Liver Biopsy.**—Biopsy of the liver may be done in three ways: laparotomy, peritoneoscopy and by the use of the punch biopsy needle. While the first of these methods is the most satisfactory as a larger biopsy specimen may be obtained and because it is done under direct vision, from the practical standpoint the other two methods may be used more frequently as a means of diagnosis. By the use of the peritoneoscope the liver is visualized and the specimen taken from a chosen site, but because of the simplicity of the needle punch biopsy method, it is gaining considerable popularity. This last method must be used with extreme care. It should not be done except in patients whose liver extends well beneath the level of the right costal margin, only when the prothrombin time is normal and only in hospitalized patients. The

with cholelithiasis, but when subnormal values are obtained, complicating parenchymal liver disease should be investigated before operation is undertaken.

Although the total cholesterol and ester results are not usually of real diagnostic help because of the normal or low figures seen at times in obstructive jaundice, as noted above, and also because hepatocellular jaundice is sometimes accompanied by elevations of the total and cholesterol ester levels, these determinations are of value in following a patient's progress. It may be said that a cholesterol ester percentage of 50 per cent or less is an indication of dangerously failing liver function.

**Albumin-Globulin Ratio.**—The chemical determination of total serum protein and its partition into albumin and globulin is used as an aid in the diagnosis of liver disease. It is particularly impaired in long-standing chronic hepatic abnormalities, but is of little value in the determination of early liver damage. Further study of the separation and measurement of protein fractions by electrophoretic methods appears to be the next step in obtaining closer correlation between liver function and protein values.

**Alkaline Phosphatase.**—Measurement of serum alkaline phosphatase in Bodansky units is frequently used in the study of liver function. Although most cases will fall into the commonly accepted range of 1.5 to 4.0 Bodansky units, we do not attach any significance to values below 7.0 units in the study of liver disease. In cases of obstructive jaundice without accompanying hepatocellular damage the alkaline phosphatase is often markedly elevated. If there is accompanying hepatocellular damage the alkaline phosphatase may be normal or only slightly elevated.

In jaundice due to hepatocellular disease unassociated with obstruction, the alkaline phosphatase levels may rise to the same range as those seen in uncomplicated obstructive jaundice, but they usually approximate 10 Bodansky units. In such cases, when the alkaline phosphatase values fall to normal or subnormal levels, the prognosis is poor, particularly when the bilirubin level rises coincidentally. The alkaline phosphatase is increased in hepatic disease without jaundice and the values in these conditions, while usually moderate, may occasionally be very high. There is no quantitative relationship between the height of the alkaline phosphatase and the severity of the liver impairment. It becomes apparent that high values of serum alkaline phosphatase have little use in distinguishing obstructive from hepatocellular jaundice in the individual case.

#### LABORATORY PROCEDURES USED UNDER SPECIAL CIRCUMSTANCES

**Plasma Prothrombin.**—Normally, prothrombin is formed by the liver in the presence of an adequate supply of vitamin K. When ob-

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danger of bleeding is definite and the procedure must be done only after due consideration has been given to the advantages to be gained compared to the dangers that may be encountered. Our experience with this procedure is not extensive.

### DISCUSSION

Although a number of liver function tests have been mentioned individually, it is important to use many of these laboratory aids as a unit in the study of any single case in which impairment of liver function is suspected. A composite study of late or residual liver damage must be made in order to obtain any significant degree of accuracy. We believe that this study should be used whenever surgery on the biliary tract is contemplated, as occasionally a dangerous operative procedure may be avoided in this way. From the practical standpoint modification in the profile tests used in an individual case may be applied as follows.

A. *When jaundice is present*, the flocculation tests (thymol turbidity, thymol flocculation, cephalin-cholesterol flocculation), urine bilirubin, urine urobilinogen, serum bilirubin (one-minute direct and total), total cholesterol, cholesterol esters, and alkaline phosphatase should be used. The prothrombin time should always be determined and if the original prothrombin reading is less than 90 per cent of normal, the test should be repeated after the administration of vitamin K to ascertain the danger of hemorrhage and the severity of hepatocellular injury. In the presence of ascites or edema, serum proteins are indicated.

B. *When jaundice is not present*, the group of laboratory aids used in these patients should include the flocculation tests noted above, urine urobilinogen, urine bilirubin, bromsulfalein and serum bilirubin, both one-minute prompt direct and total.

The laboratory aids, which under certain circumstances may prove of valuable prognostic significance are: the cholesterol and cholesterol esters, alkaline phosphatase, prothrombin and tyrosine crystals in the urine.

In the routine use of a series of tests for hepatic function, we have observed in several patients with metastatic carcinoma of the liver, moderate to marked degrees of bromsulfalein retention while the flocculation tests have given normal values. When this combination of results is found, consideration should be given to the possibility of metastatic carcinoma of the liver.

When there is evidence of severe hepatocellular damage in conjunction with obstructive jaundice, there is much to be gained by delaying the surgical procedure until maximal improvement can be obtained by medical therapy.

## CHOLANGIOGRAPHY

MAGNUS I. SUEDAL AND C. FRANKLIN SORNBERGER

VISUALIZATION of the biliary tract by means of opaque media is reserved, in this clinic, primarily for those cases in which a plastic operation or a repair of a common duct has been performed or when the common duct has been opened and a T-tube left in it. In rare instances in which anomalies of the common duct have been en-

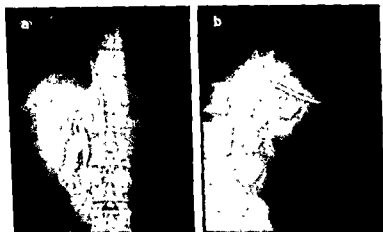


Fig. 170, a and b—Normal cholangiograms (a anteroposterior and b lateral) taken eight days after a cholecystectomy and choledochostomy with insertion of the T-tube. The findings at operation were cholecystitis with numerous small cholesterin stones, some of which were impacted in the common bile duct, and cholangitis secondary to biliary stasis. The T-tube was removed on the tenth postoperative day.

countered at operation, subsequent cholangiography may be of value to determine function. In some groups it is routine practice to make cholangiograms during the initial operative procedure before opening the common duct, but this is not done in this clinic. Cholangiography is used entirely as a diagnostic procedure following a surgical operation.

Diodrast is the medium employed and only occasionally is it injected under fluoroscopic control. The usual technic is as follows: with the patient supine on the radiographic table, 10 cc. of diodrast is injected under sterile conditions into the T-tube, using a syringe and exerting no more pressure than would be necessary for intravenous injection. The biliary tract can be filled with diodrast by the force of gravity





Fig. 172.—Air in the gallbladder before cholecystgastrostomy was disconnected

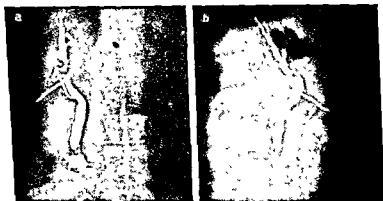


Fig. 173, a and b.—Cholangiograms (a anteroposterior and b lateral) illustrating partial obstruction of the common duct owing to numerous stones in the biliary tract. The patient had previously had a cholecystectomy and choledochostomy elsewhere and the T-tube was still in position. At the second operation numerous stones were removed from the common duct and a second cholangiogram taken twelve days later was normal.



Fig. 171.—Normal cholangiogram taken on the twelfth postoperative day. This patient had had a cholecystgastrostomy elsewhere six years previously and at the second operation cholecystitis with stones was found. The cholecystgastrostomy was disconnected, and a cholecystostomy and choledochostomy were done, with insertion of the T-tube into the common duct. The T-tube was removed on the thirteenth postoperative day.



Fig. 176—Cholecystjejunostomy with a dilated proximal common bile duct that is obstructed. Note the retrograde filling of the cystic duct and a portion of the gallbladder. A follow-up film fifteen minutes after injection showed that most of the dye had left the biliary system.

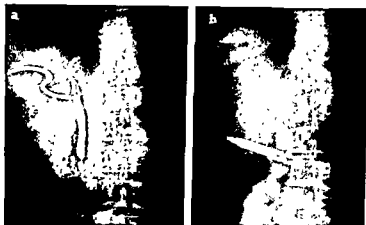


Fig. 174, *a* and *b*.—Slight narrowing of the distal common duct without obstruction. The roentgenograms were taken fourteen days after operation following cholecystectomy with choledochostomy and insertion of the T-tube; *b* was taken thirty minutes after *a*. At operation, the gallbladder was full of necrotic stones and one stone was lodged in the distal end of the common duct. Because of the marked regional inflammatory process, a small portion of the liver adjacent to the gallbladder was also resected. Microscopic examination of the liver specimen showed marked periportal inflammation and fibrosis.

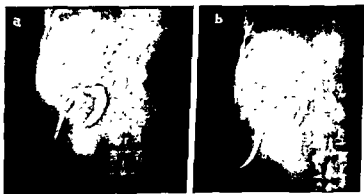


Fig. 175.—This patient, at operation, had numerous stones packed into the common duct. Cholangiogram nine days postoperatively showed residual narrowing of the lower end of the common duct in *a*, and in *b*, thirty minutes later. Note that there is slight delay in drainage.

inherent in the up-ended T-tube itself when the free end is no more than 10 inches long. Using the syringe method, we stop the injection at the slightest evidence of resistance and proceed with the radiography. Our routine for taking films consists of making a plain film

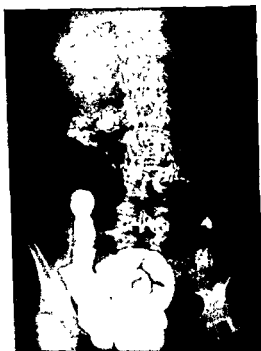


Fig. 178 —A portion of the biliary tract outlined by gas in a case of chronic intermittent biliary obstruction with cirrhosis.

before injection, an anteroposterior stereoscopic and a right lateral film of the right upper quadrant of the abdomen immediately after injection and a single anteroposterior and occasionally a right lateral film fifteen to thirty minutes after injection. The T-tube is clamped immediately after injection and remains clamped until the fifteen or thirty minute film has been taken. Film size used is either 10 by 12 or 11 by 14 inches, depending upon the size of the patient.



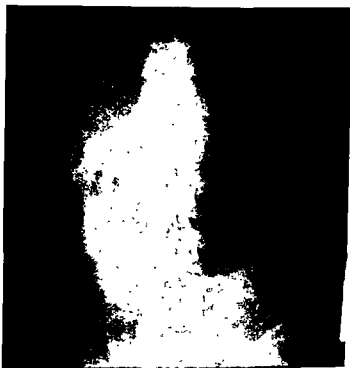


Fig. 177 —Gas in the gallbladder of a patient in whom a cholecystduodenostomy had been done.

# MEDICAL MANAGEMENT OF DISEASES OF THE BILIARY TRACT

SARA M. JORDAN

THE medical management of biliary tract disease concerns the surgical and purely medical types. In the former, preoperative and postoperative management is often as important as the operation itself in the attainment of a successful outcome.

The most important disease of the biliary tract is cholecystitis with or without stones. There has been and still is controversy regarding the necessity for surgery in either of these conditions. The subacutely inflamed gallbladder and the so-called "silent" stones have by some been regarded as innocuous. Impressive statistics may be quoted regarding the autopsy findings of healed inflammatory lesions and stones which have never caused symptoms during the life of the patient. While these statistics indicate that certain individuals do escape the penalties of this pathologic condition in the biliary tract, they give no data on the equally impressive fact that stones which are "silent," sometimes even for years, may cause sudden and irrevocable disaster. Perforation, obstruction, inflammation of the cystic and common ducts and secondary liver damage and pancreatitis may occur without warning and give rise to irreparable damage. This is not only a possibility but is so frequently a clinical experience that gallstones are, in our opinion, never innocuous even though "silent" and in all cases are an indication for surgery.

With that policy established, accuracy of diagnosis is of the highest importance. It is as necessary to be certain that gallstones are actually present as it is to urge their removal if they are present. While the history may be completely typical, with mild to excruciating upper abdominal pain radiating to the angle of the scapula and sometimes to the neck, and attended by vomiting, such an attack of acute indigestion is not always due to gallbladder disease and gallbladder disease is not always attended by such violent symptoms. In other words, one may strongly suspect but not diagnose by the history alone. Tenderness in the right upper quadrant after such an attack is additional evidence for gallbladder disease, but again not entirely conclusive.

The Graham-Cole method of visualization of the gallbladder, especially with the use of the newer dye preparations, is practically infallible when all conditions are perfect, but as with all tests this is often impossible to attain. A normal gallbladder may not fill because of spasm of the sphincter of Oddi associated with a spastic condition elsewhere in the digestive tract as, for example, the pylorospasm associated with duodenal ulcer or the general spasticity found with irritable colon. In these patients a period of medical treatment will relieve the spasm and permit normal filling.



cases, cholecystectomy must be postponed, sometimes indefinitely. However, modern preoperative and postoperative care, combined with the recent advances in anesthesia, have made it possible to cope with all but the most serious complications so that cholecystectomy may be safely carried out.

Not infrequently, extraneous circumstances also prevent a patient from having cholecystectomy done as soon as it is indicated and it becomes necessary to put such a patient with gallstones on an ambulatory regimen for weeks or months before the operation can be performed. It has been considered good usage in the past to advise a fat-free diet and a cholagogue in such cases. In our experience, these measures are not indicated if there is no jaundice or liver damage. The jaundiced patient, of course, requires special preoperative care and operation as soon as it can safely be done.

The patient, however, without liver damage should be treated with the same regimen given to patients with functional indigestion of any type. This is done in order to prevent spasm elsewhere in the gastrointestinal tract since such spasm is frequently associated with spasm in the cystic duct. This in turn gives rise to stasis in the gallbladder with resultant inflammation and stone formation.

The nutritional state of the patient is important. The obese should have weight reduction measures, including the omission of fats, during the preoperative period, since the desirability of the nonobese state for all surgery is beyond question. On the other hand, the malnourished patient can be treated preoperatively with the inclusion of easily digestible fats, such as cream and butter, in his diet with complete impunity. It is necessary, however, to have these diets conform to the easily digestible type. There must be no food from frying pan or deep fat and no pastries, cakes made with fats, or shortbreads. In such foods fat is so combined with other food materials that extra digestive effort is required to break down the combination. It is this extra effort which creates spasm and cholecystic disturbances. Often raw fruits and vegetables, pork products and veal, corn products, candies and nuts, salad dressings and condiments have the same disturbing effect and must, therefore, be avoided during this preoperative period. Supplementary vitamin therapy and a good hygienic regimen of rest and exercise are likewise valuable preoperative measures.

Complete relief of symptoms may be the result of such preoperative treatment but if this is the case, the policy of cholecystectomy, even for silent stones, must still be urged.

For the patient who has had functional indigestion combined with gallbladder disease, a careful postoperative dietary and antispasm regimen is an indispensable adjunct to surgery. The hospitalization following cholecystectomy provides an excellent opportunity for this treatment, which is usually called bowel management, since the so-called irritable colon is the obvious locus of dysfunction. Hypermotility

The interpretation of radiolucent shadows in the gallbladder area is frequently difficult because of the shadows of intestinal gas which closely resemble those of cholesterol stones. If such shadows are outlined by rings of increased density and are present in all films before and after contraction of the gallbladder it is practically certain, however, that they represent stones. Release of the gallbladder from gas shadows can sometimes be obtained by taking films in the upright position. These films are especially satisfactory in the nonobese patient and particularly when compared with those taken in the prone position.

If there is still doubt after careful evaluation of the Graham-Cole test, it is sometimes wise to treat the patient conservatively and for functional digestive disturbances for a short period of time, usually from a week to several weeks, and repeat the test.

In our experience it is unwise to advise surgery for gallbladder disease until a complete gastrointestinal survey has been appended to a thorough history and physical examination. One should be cognizant of the presence or absence of peptic ulcer, diverticulosis, irritable colon, achlorhydria, gastritis, regional enteritis or colitis as well as neoplasm or benign tumors before cholecystectomy is advised. Preoperative decision should be made as to the necessity for other treatment before or after cholecystectomy.

The presence of gallstones is, we believe, an irritating factor in peptic ulcer, irritable colon and gastritis, and cholecystectomy should be followed immediately postoperatively by medical management of such conditions. A previously refractory duodenal ulcer often heals very satisfactorily when the irritation of a diseased gallbladder has been removed.

The removal of a diseased gallbladder, on the other hand, does not by any means cure a patient of his symptoms if those symptoms have been due at least in part to the functional digestive disturbances which we call the irritable colon.

For practical consideration, there are two groups of patients with gallbladder disease: first, the group who have had intermittent attacks of upper abdominal pain, usually localizing in the right upper quadrant and referred to the angle of the scapula, and who between attacks have no residue of indigestion. When the gallbladder is removed from the patient in this group his symptoms disappear. The second group is almost constantly disturbed by chronic indigestion, constipation or diarrhea and often shifting distress ascribed to gas, with or without distention. These patients have an irritable colon which, unless treated postoperatively, will continue to cause the same symptoms as before operation.

It is, therefore, of prime importance for the postoperative well-being and happiness of the patient to determine by clinical evaluation into which group his symptoms place him.

In some instances of serious disease elsewhere, as in severe cardiac

disease was mentioned. Except for the occasional parasitic involvement of the gallbladder and biliary tract with such organisms as the *Giardia*, *Echinococcus*, *Ascaris* and *Taenia*, which require specific antihelminthic therapy, only functional disturbances of the biliary tract can be considered purely medical. In the consideration of such functional disturbances it is important to recognize the integration and coordination of the biliary tract with stomach, small intestine and colon. The mechanical phenomenon of spasm which is the factor underlying most dysfunctions elsewhere in the digestive tract is likewise responsible for cholecystic and common duct dysfunction. There may be pain in the right upper quadrant and a nonfilling gallbladder with the Graham test, due entirely to a functional disturbance and occurring concomitantly with such disturbances in the colon, small intestine and stomach. *The same treatment as described above for the postoperative patient should be used in these cases and when there is no organic complication, this treatment will be adequate.*

In conclusion it should again be stated: (1) that inflammation of the biliary tract and stone formation are always surgical conditions; (2) that combined with surgical treatment there is need for preoperative management in certain cases and for postoperative medical treatment in the large majority of cases. The importance of concomitant functional disturbances cannot be overemphasized if the goal of complete relief of symptoms is to be attained.

of the small intestine as well as pylorospasm is, however, usually a concomitant condition and is relievable by the same treatment. For the first few days after cholecystectomy a very bland diet is used; such foods as cream of wheat, milk toast, soft poached egg on toast, malted milk, weak tea and warm milk are used in frequent small feedings. Heat is applied to the abdomen at regular intervals and only warm food and drink are given, hot water being used as much as desired. On the second or third day, belladonna or some synthetic antispasmodic is given, either with or without small doses of phenobarbital. The usual postoperative gas distress is thus minimized or completely prevented and the digestive tract is protected with as much rest as is compatible with some nutritional function. Gradually, other easily digestible foods are added, including meats, except pork and veal, and cooked vegetables, exclusive of the cabbage group, turnips, tomatoes and corn. Experience shows that garden lettuce without dressing, celery and raw carrots may be used in most cases. The only raw fruit allowed is orange juice and this must be diluted with hot water. Cooked fruits, including canned fruits, best cooked again after removal from the can, may finally be added. Soft puddings and custards may be added in the early stages of this diet. No ice cold food or drink is included. On the third day, a saline rather than a soapsuds enema is given and from then on small retention oil enemas are given when necessary supplemented only when absolutely necessary by saline enemas. Frequent rectal examinations indicate the need for such intervention. No postoperative laxatives are used. If there is a functional achlorhydria, as determined preoperatively, hydrochloric acid is prescribed and the condition again checked postoperatively. Hyperchlorhydria is likewise checked and controlled.

In cases of long-standing chronic indigestion, such a bowel management regimen must be continued for some months or even permanently after cholecystectomy in order to have complete and permanent freedom from symptoms. In cases of habitual constipation and laxative abuse, a gradual resumption of normal bowel function will be attained with a permanent omission of laxatives.

It cannot be overemphasized that patients with chronic indigestion and gallbladder disease require this postoperative management for full relief of their symptoms. The disgruntled unhappy patient who "still has the same trouble" after removal of the gallbladder is in most cases suffering from an untreated functional disturbance concomitant with and irritated by a diseased gallbladder but unrelieved by the mere removal of the gallbladder.

Cholecystic disease includes polyp of the gallbladder and malignancy of the gallbladder or of the ampulla of Vater. In all these conditions medical management consists only of as early diagnosis as possible and a postoperative regimen designed for palliation of symptoms and protection of digestive function.

At the beginning of this paper, a purely medical type of biliary tract

## PREPARATION OF THE JAUNDICED PATIENT FOR SURGERY

FRANCES H. SMITH

THE preparation of the jaundiced patient for surgery does not depend so much on the cause of his jaundice as it does upon the amount of liver damage associated with it. This can be determined with considerable accuracy by use of the liver function tests described elsewhere in this issue. In addition, other pathologic states are frequently associated with the liver damage, directly or indirectly dependent upon it or upon the disease process responsible for the jaundice, which require specific therapy. The most important of these are anemia, malnutrition, avitaminosis and impaired electrolyte and fluid balance.

**Anemia.**—The rapid restoration to normal of blood deficient in cells or hemoglobin is, of course, accomplished most readily by transfusions of whole blood. The number of transfusions required in a particular case is variable. At the Lahey Clinic a hemoglobin of 12 gm. and a red cell count of 4,000,000 is considered an absolute minimum in a patient about to be operated upon. If time and available blood permit, a normal hemoglobin and red cell count should be obtained.

If the patient is to be prepared over a period of a week or more, which is frequently necessary in cases of severe liver damage, an oral iron preparation should be given in conjunction with the transfusions in cases of hypochromic anemia. The elixirs of iron are contraindicated in liver disease.

**Malnutrition.**—Malnutrition plays an important role in the prognosis of many jaundiced patients. The extent of this process is often difficult to gauge, particularly in the obese patient. The safest guide is found in the determination of the total serum protein and the albumin and globulin fraction. It must be emphasized that it is the absolute amount of these components rather than the albumin-globulin ratio which is important. In using these determinations as criteria it is important to make sure that the patient is adequately hydrated. In a dehydrated patient a total protein of 6.4 gm. per 100 cc., for example, may, after an intake of 3000 cc. of fluid for two days, decrease to 4.2 gm. or lower. In this same connection it should be borne in mind that one of the commonest causes for elevation of the globulin fraction is dehydration, so that until dehydration is corrected this finding is not an indication of liver damage.

The correction of malnutrition in patients with liver damage is not always an easy process. The malnutrition may be due to persistent vomiting with or without diarrhea, to anorexia, or to deficient absorption with or without the other factors mentioned. In any case, a high calorie, high protein, high vitamin diet in which the fat intake is cur-





food but who can take fairly large quantities of semisolids the pre-operative regimen is as follows:

## SEMI-LIQUID DIET

7 A.M.	Milk	1 glass (medium size)
8 A.M.	Cereal (Pablum)	Generous cupful
	Sugar	3 heaping teaspoonfuls
	10% cream	2 tablespoonfuls
	Whites of 2 eggs	
9 A.M.	Orange juice	1 glass (medium size)
10 A.M.	Eggnog*	
	Milk	1 cup
	White of 1 egg	
	Sugar	3 heaping teaspoonfuls
11 A.M.	Cream soup	1 glass
	Mashed potatoes	(1 medium size potato)
	Pureed vegetables	$\frac{1}{2}$ cup
	Orange juice	1 glass
12 Noon	Cocomalt	1 glass
2 P.M.	Eggnog	As above
3 P.M.	Orange juice	1 glass
4 P.M.	Cereal (Pablum)	
	Sugar	3 heaping teaspoonfuls
	Skimmed milk	$\frac{1}{2}$ cup
	Jello	$\frac{1}{2}$ cup cooked
	Skimmed milk	$\frac{1}{2}$ cup
	Orange juice	1 glass
5 P.M.	Cocomalt	1 glass
6 P.M.	Eggnog	As above
7 P.M.	Eggnog	As above

\* One or two eggnogs may be made with the whole egg; the remainder should be made without the yolks because of their high fat content.

This may be supplemented by parenteral fluids and vitamins as above.

For those who can take little, if anything, by mouth, the customary procedure is to give 3000 to 4500 cc. of fluid daily parenterally of which 1000 to 2000 cc. are amino acids, 1000 to 2000 cc. are 10 per cent glucose in water, and the remainder blood, plasma or physiologic saline solution.

**Avitaminosis.**—Because of its vital relationship to bleeding in patients with jaundice with or without liver disease, *avitaminosis K* has attracted the greatest amount of attention from the standpoint of both diagnosis and treatment. Postoperative bleeding in these patients was a common finding difficult to control and frequently fatal before the studies of Quick in 1937 and Warner, Brinkhous and Smith in 1938 showed it to be due to inadequate prothrombin in the blood. This deficiency is a result of either a failure of absorption of vitamin K from the intestine or the inability of the liver to use the vitamin in the production of prothrombin.

tailed has been shown by numerous investigators to be of great importance in protecting the liver, not only against the disease for which operation is necessary, but also against the associated trauma of surgical procedures, anesthesia, and metabolic disturbances of the postoperative period. During the latter period the liver is frequently called upon to combat shock, to detoxify the sulfonamides or other antibiotics and sedatives, as well as to take the leading part in reparative processes.

In the work done initially on protecting the liver against operation it was thought that carbohydrate was the most important of the nutritional factors. Later, however, it was shown that amino acids, particularly the sulfur-bearing amino acids, had as important if not a more important place. Both of these schools of investigation agreed that fat should be reduced to a minimum. Lately, however, some investigators have advanced the theory that amounts of fat necessary to make the diet palatable and hence insure a high caloric intake is of greater importance than a diet which is so low in fat that it is unpalatable and therefore not taken. In our hospitalized patients, however, we have not found it necessary to give more than 40 to 50 gm. of fat per day to make the diet acceptable.

A diet containing 110 to 140 gm. of protein, 350 to 450 gm. of carbohydrate and not more than 40 to 50 gm. of fat for patients who can tolerate solid food may be prepared as follows:

<i>Breakfast</i>	<i>Luncheon</i>	<i>Dinner</i>
1 cup fruit juice with 2 tsp sugar	Lean meat—slice 4 by 2 by $\frac{1}{2}$ inches	$\frac{1}{2}$ cup cottage cheese or small serving lean meat
Cereal allowed with 2 tsp. sugar	Potato substitute	Cooked vegetable
$\frac{1}{2}$ cup skim milk	Cooked vegetable	1 slice white bread or crackers
1 slice toast	1 slice white bread or crackers	1 tsp. butter
1 tsp butter	1 tsp. butter	1 tb jelly
1 tb. jelly	1 cup fruit juice with 2 t-p sugar	Cooked fruit
	Dessert	Hard candy—1 ounce
		Fruit juice—1 cup with 2 tsp. sugar

This diet should be supplemented by accessory feedings composed of 1 cup of skimmed milk, 2 to 4 tablespoonfuls of a protein supplement such as *Dietene*, *Casec*, *Essenamaine* or similar preparations, with flavoring and 1 teaspoonful of sugar. The accessory feedings are best given one hour after the preceding meal, three times a day, in order not to dull the appetite for the succeeding meal. This regimen provides an intake of 2000 to 3000 calories a day.

Additional supplements, depending upon the general condition, of 1000 to 2000 cc. of 10 per cent glucose in water parenterally with added vitamins may be given. For patients who are unable to tolerate solid

mg. of thiamine chloride. In patients who can tolerate oral preparations 2 tablets three times a day of vitamin B complex or 1 teaspoonful of liquid vitamin B may be given. These preparations are of greater value than the concentrated preparations which, because they are synthetic, are composed of certain components only of the B complex. If these occur in unbalanced amounts they may harm rather than help the liver. In addition, the liquid preparations and crude liver extract furnish almost all of the B complex (thiamine is lacking in crude liver) and because this is true are more naturally balanced preparations. It is the balanced preparations which are of therapeutic value to the damaged liver.

There has been considerable investigation of the effect of *vitamin C* on tissue healing. Our practice is to give 500 mg. once a day in the immediate preoperative and postoperative periods and 50 mg. three times a day for a month to six weeks following discharge from the hospital in addition to the dietary intake of this vitamin. In patients with fatty livers choline chloride 4 to 6 gm. a day in divided doses has proved of value. This should be administered in simple syrup. If a 50 per cent solution is used, 1 to 2 teaspoonfuls with each meal furnishes the required amount.

The remaining known vitamins are not thought to be of particular significance in patients with liver disease and no special care is taken to supply them to the patient unless need for them arises from coexisting deficiency states.

**Electrolytes.**—The importance of the electrolyte balance in any patient, particularly those about to undergo operation or upon whom major surgical procedures have been done, hinges upon the roles of sodium and potassium as osmotic forces governing the distribution of the intracellular and extracellular fluid of the body. Sodium largely occurs as sodium chloride; therefore, determination of the chloride level will give, for practical purposes, an accurate picture of the sodium concentration. Since the sodium and potassium ratio is fixed except in certain diseases no further investigation need be undertaken. A few basic physiologic considerations are helpful. The average patient requires 5 to 6 gm. of salt daily. When vomiting, diarrhea, high fever, diaphoresis, fistulas or drainage from the gastrointestinal tract give rise to increased loss of chloride beyond the normal daily loss, the requirement is increased. Fluid lost in this way should be replaced volume for volume by physiologic saline solution. If this is *not* the case 600 to 700 cc. of normal saline solution daily, given intravenously or by clysis, to patients in whom parenteral administration is necessary, is sufficient to maintain the chlorides at a normal level.

The importance of giving enough and no more cannot be sufficiently stressed. Too frequently, the practice of giving 1000 to 1500 cc. of normal saline solution daily after operation is considered routine. In young patients with adequate cardiovascular-renal reserves the body

In cases in which the disturbance is primarily obstructive, vitamin K, a fat-soluble substance, is not absorbed from the intestine because the lack of bile salts prevents the lowering of surface tension necessary to permit fat-soluble substances to traverse the intestinal mucosa. In severe liver disease, although vitamin K is readily available, the liver may be unable to utilize it to manufacture prothrombin.

In obstructive jaundice, therefore, parenteral administration of vitamin K will cause a rise in the prothrombin level. This is readily accomplished after a latent period ranging from hours to days by the intramuscular administration of one of the synthetic naphthoquinone derivatives in amounts varying from 4.8 mg. to 9 mg. per day.

In patients with severe liver disease the prothrombin can be restored only by giving transfusions of whole blood or plasma. It is important to remember that prothrombin is rapidly destroyed in alkaline solutions and at room temperatures, so that citrated blood and blood which has been kept for twenty-four hours or longer at room temperature are not suitable for restoring lowered prothrombin levels to normal. Plasma separated from fresh blood and immediately frozen retains most of its prothrombin activity for months, as does desiccated plasma. In the latter, reconstitution of the plasma with 0.1 per cent citric acid instead of distilled water does much to preserve the prothrombin activity which is otherwise lost.<sup>4</sup>

*Vitamin A deficiency* also is frequently found in the jaundiced patient. Like vitamin K, it and its precursor carotene are fat-soluble and depend on bile salts for adequate absorption through the intestinal mucosa. When carotene is available to the liver it is there changed to vitamin A. Deficiency in vitamin A is widely associated with night blindness so that this aspect of the deficiency is often regarded as the only one. It should be remembered, however, that the health of the epithelial structures of the body depends on adequate supplies of vitamin A and that this is applicable to the epithelial lining of the gastrointestinal tract including the biliary system. It is possible, therefore, that vitamin A deficiency may in some instances play a part in transient or permanent obstruction to the common bile duct following operation involving this structure. Doses of 5000 to 10,000 units a day are recommended which may be administered by capsule. Prolonged larger doses may depress the prothrombin level.<sup>5</sup>

*Vitamin B* is stored by the liver. So much has been written and so much is being discovered about the several fractions of this complex that no attempt will be made to summarize its role in this article. It should be stressed that various fractions of vitamin B complex are essential to the metabolism of carbohydrate and since carbohydrate forms so much of the caloric intake of patients with liver disease, it is mandatory that vitamin B complex be given in adequate amounts to these patients. This is best supplied by intramuscular injections of crude liver extract, 3 cc. daily or on alternate days together with 10

detoxified by the liver it is not a respiratory depressant so that the dangers of overdosage are not comparable.

In giving barbiturates to patients with liver damage it is important to avoid those which depend for their intensity and duration of action on rapid destruction by the liver. Even those barbiturates which have an alternate route of excretion by way of the kidney may exert several times their usual effect in the presence of liver damage so that they must be used with caution.

Intravenous alcohol, which is useful postoperatively as an anodyne and to combat depression, should be carefully avoided in patients with liver disease.

**Pruritus.**—The problem of itching is frequently troublesome. No single safe method has been found which affords relief in every case. Adequate sedation is necessary in the severe cases. In milder cases the intravenous injection of 1 gm. of calcium gluconate in 10 cc. of saline solution administered slowly once or twice daily, has given relief.

Starch or oatmeal baths or the local application of calamine lotion with 0.5 per cent phenol may be employed with benefit.

Preparations of ergot should not be used for the relief of pruritus in patients with liver disease, since serious accidents have been known to occur.

### SUMMARY

The preparation of the jaundiced patient is discussed in respect to the following: (1) anemia, (2) nutrition; (3) vitamins A, B, C and K; (4) electrolytes; (5) fluids; (6) sedatives and analgesics, and (7) pruritus.

Methods of administration, amounts to be given and contraindications are specified.

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can withstand this unphysiologic onslaught. In older patients and in those with diminished cardiovascular-renal reserves a dire train of results may follow. The increased sodium chloride causes retention of tissue fluid which reaches considerable amounts before its presence is suspected. Its early manifestations may take the form of drowsiness, pylorospasm with vomiting, constipation or distention. Increasing edema may endanger the safety of suture lines and wound disruption may occur. When the warning signals are unrecognized, generalized edema may develop, irreversible processes be established and death result.

In patients with hypochloremia roughly 0.5 gm. of sodium chloride per kilogram of body weight is needed for each 100 mg. less than 560 mg. per 100 cc. For example, for a 70 kilogram patient with a plasma chloride of 370 mg.,  $0.5 \text{ gm.} \times 70 \times 2 = 70 \text{ gm.}$  salt is needed to restore the serum chloride to the normal level.

In patients in whom oral feedings may be given, this may be supplied in the form of salt tablets (usually best tolerated in the enteric-coated form), by salt in water, and by the liberal use of salt with the meals. When it must be given parenterally 4000 to 6000 cc. of normal saline solution daily will restore the balance in thirty-six to forty-eight hours. It is of considerable importance, however, to check the patient's progress by plasma chloride determinations every twenty-four to forty-eight hours when the patient is in the critical preoperative and postoperative period or when large amounts of fluids are being administered.

**Fluid Balance.**—In addition to the consideration already mentioned regarding nutrition and electrolyte balance, the maintenance of the fluid balance depends upon supplying sufficient fluid to provide for adequate kidney function. A urinary output of 1200 cc. a day with a specific gravity of at least 1.015 should be considered a minimum to guard against nitrogen retention. In some instances the output may be as low as 600 cc. if the specific gravity is high (1.020 to 1.030) without the retention of nitrogen. Conversely, if the specific gravity is low, a greater output must be secured (2500 to 3000 cc. if the specific gravity is 1.008 or lower).

**Sedatives and Analgesics.**—In any discussion of the preoperative care of the jaundiced patient it is important to consider the types of sedatives which may be used to best advantage.

Morphine, which is 90 per cent detoxified by the liver, is contraindicated if there is associated liver disease. Since this drug is the one most frequently employed routinely in general preoperative and postoperative care, this fact deserves special emphasis. Demerol is an adequate substitute and may be given in doses of 50 to 150 mg. parenterally and later orally every four hours as needed.

Codeine (1 grain) hypodermically every four hours may provide adequate analgesia. Although this drug, like morphine, is largely

## GALLSTONES—A SURGICAL PROBLEM

SAMUEL F. MARSHALL

THE surgical treatment of diseases of the biliary tract constitutes to a large extent the treatment of the calculous gallbladder and its complications. This volume presents a discussion of the diseases of the biliary tract, many of which trace their origin directly to the presence of stones in the gallbladder. Progress in this field of medicine is related directly to early clinical recognition of cholecystitis and cholelithiasis and especially their causal relationship to the development of many serious complications resulting from delayed treatment.

It is a well established fact that gallstones occur twice as commonly in women as in men and that the incidence of gallstones increases with age. In a recent report from this clinic of 1104 cases, the proportion of females to males was 3 to 1. Dessau found in autopsy material that in patients under the age of 40 the incidence of gallstones was 1.5 per cent whereas the incidence rose rapidly thereafter until of those individuals aged 80 years, more than one third had gallstones. Robertson estimated that 10 to 20 per cent of individuals over the age of 30 have gallstones; women admittedly are more subject than men, in the proportion of 2 to 1. He also stated that in the present state of our medical practice about 50 per cent of gallstone cases remain undiagnosed.

Obviously, silent gallstones do exist without symptoms in a few cases, but these cases must be relatively infrequent and probably are those that escape the attention of the patient or attending physician, or are found at laparotomy done for other reasons or discovered at autopsy.

If the incidence and frequency of occurrence of gallstones were fully recognized, symptoms could be elicited in the majority of cases by careful questioning on the part of the physician, and these symptoms could be directly traced to the presence of disease of the gallbladder and easily verified by proper diagnostic procedures. Just what percentage of individuals with stones show signs or symptoms of gallstones would be difficult to estimate. A correct diagnosis, however, can be made in a high percentage of cases by roentgen examination in patients coming to operation—in 97.6 per cent according to Adams' recent study of operated cases.

Once the diagnosis of gallstones is established, surgical treatment in the majority of cases should be advised and instituted as early as possible. It will be conceded that treatment of patients with gallstones presents an individual problem in each case and every patient should be accorded the treatment which will result in the greatest benefit to that individual. This will mean, of course, in a few instances that





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surgical treatment may need to be deferred or even abandoned because of age or serious complicating factors, such as heart disease or other more serious organic disease. By far the majority, however, should have cholecystectomy as early as possible. Admitted that silent gallstones do exist, it is difficult to concede that gallstones are harmless. The many complications that result from delay in the treatment of patients with gallstones could be avoided by early recognition and early surgical interference. Most of the morbidity and mortality is directly associated with these obviously preventable complications. Any improvement, therefore, in the results of surgery of the biliary tract must result from earlier diagnosis and earlier surgical treatment.

The various complications of cholecystitis and cholelithiasis are fully discussed under separate headings in this volume. For the sake of emphasis, it is probably of value to list the complications more or less directly related to stones in the gallbladder. In relative order of their frequency they are: common duct stones, acute cholecystitis, cholangitis, hepatitis, and pancreatitis, acute or chronic. Some of the more uncommon complications are hydrops of the gallbladder and carcinoma arising in the gallbladder, various internal biliary fistulas resulting from perforation of the gallbladder or biliary ducts and the less common complication of intestinal obstruction due to gallstones. Carcinoma of the gallbladder is uncommon but almost always arises in the presence of gallstones. Boyd stated that calculi are present in from 80 to 90 per cent of patients with carcinoma of the gallbladder. In a discussion in this volume of malignant tumors of the gallbladder in this clinic, Swinton found gallstones present in every instance of malignant gallbladder.

*Stones in the common duct present one of the most frequent complications of the calculous gallbladder.* It is well recognized that patients with long-standing neglected stones in the gallbladder are likely to have stones also in the common duct. Colcock, elsewhere in this volume, describes the indications for exploration of the common bile duct. It should be emphasized, however, that a contracted calculous gallbladder is evidence of profound, long-standing infection, and is often associated with stones in the common bile duct. In every case of contracted gallbladder the common duct should be opened and explored for stones.

Internal biliary fistulas between the gallbladder and duodenum, or bile ducts and intestine or stomach are not uncommon complications of neglected gallstones. Tracey reported 21 cases of spontaneous internal fistulas over a period of fifteen years in this clinic. Most cases are discovered by barium studies of the gastrointestinal tract (Fig. 179) and are found to be communications between the gallbladder and duodenum in the majority of cases. Still more uncommon is the occurrence of intestinal obstruction caused by gallstones eroding through into the duodenum and usually producing obstruction by impaction of the

gallstone at the ileocecal junction. This complication has been discussed previously in a paper from this clinic.

A discussion of the diagnosis of gallstones is presented by McKell in this volume. It has been stated that a correct preoperative diagnosis can be established by roentgen examination in 97.6 per cent of cases. It would be well to emphasize, however, that gallstones may be

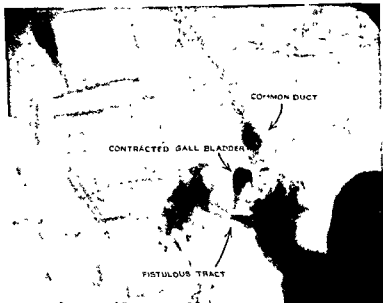


Fig 179 —Spontaneous cholecystoduodenal fistula occurring in a calculous gallbladder. In this roentgenogram of the stomach and duodenum barium is shown passing through a fistula connecting the first portion of the duodenum and the contracted gallbladder and filling the common bile duct with barium.

present and yet not demonstrated by roentgen examination of the gallbladder. With a history of repeated symptoms suggesting gallstone colic and in the absence of demonstrable disease elsewhere in the gastrointestinal tract, we are justified in advising cholecystectomy, and in the majority of patients small stones in the gallbladder will be found or occasionally symptoms caused by deposits of cholesterol on the gallbladder mucosa—a strawberry gallbladder (Fig. 180)—may be present. One should also consider as a complication of cholelithiasis recurrent symptoms that necessitate reoperation; these cases will comprise those patients with symptoms arising from unremoved remnants of the gallbladder, overlooked stones in the cystic or common ducts, postoperative strictures of the common duct and foreign bodies in the common duct. In one such patient recently operated on who had previously had a cholecystectomy, three large knotted silk sutures were

found in the common duct. The duct had not been opened at the initial operation and probably the sutures sloughed into the common duct from the ligated cystic duct.

Another complication noted following an earlier surgical procedure and which requires reoperation occasionally, occurs after cholecystostomy which has previously been done for acute cholecystitis with stone. I refer to the occasional case of persistent fistula at the site of the



Fig. 180.—Strawberry gallbladder—cholesterolosis of the gallbladder. Mucosa of the gallbladder is studded with deposits of cholesterol. These yellow dots of cholesterol occurring on the reddened mucosa resemble the seeds of a ripe strawberry.

*abdominal incision for the cholecystostomy.* The drainage from the fistulous tract is, in the main, mucus and purulent material with no admixture of bile, caused by obstruction of the gallbladder with an unremoved stone at the ampulla of the gallbladder. This drainage can be remedied by excision of the fistulous tract and cholecystectomy. In general, in most cases in which cholecystostomy has been performed, symptoms of gallbladder disease again develop, necessitating a second operation consisting of cholecystectomy.

These complications should more rightly be considered complications of inadequate surgical procedures, but nevertheless they carry a morbidity and mortality which may be high, and in almost every instance they represent an avoidable complication.

One cannot discuss complications of gallstones without reference to jaundice and its cause. Although jaundice is a symptom in a large number of cases of obstruction of the common bile duct, it is well to

emphasize that a common cause of obstruction is stone in the common duct or jaundice may be due to hepatitis associated with infections arising in a calculous gallbladder. Adams, in his series of 1104 cases, found that 52 per cent of the patients with a history of jaundice (200 cases) had stones in the common duct. This is a serious complication and obviously could be avoided by earlier diagnosis and surgical intervention. *The preparation of the jaundiced patient for operation* entails considerable preoperative care and is a considerable economic factor in prolonged hospital stay, cost of medication, and so forth, besides an added risk to operative interference.

A brief summary of biliary tract surgery done in the Lahey Clinic from 1910 to 1945 inclusive is presented in Table 1.

TABLE 1

Years	Number of Patients	Common Ducts Explored		Common Duct Stone		Common Ducts Explored Found To Have Stones, Per cent	Post-operative Deaths	Operative Mortality, Per cent
		No	Per cent	No.	Per cent			
1910-1929	1050	236	22.4	122	11.6	51.7	50	4.76
1930-1933	493	198	40.2	98	19.8	49.0	11	2.2
1934-1937	634	284	44.8	103	16.2	36.3	20	3.1
1938-1941	909	441	48.8	128	14.0	29.0	21	2.3
1942-1945	1104	504	45.7	186	16.8	37.0	10	0.9
Total	4190	1666	39.7	617	15.2			

It is of interest to note the decreasing operative mortality over the years and we believe it is evidence that surgical treatment of gallbladder disease offers an increasing margin of safety to the individual with disease of the biliary tract. Improvements in results are related to better preoperative preparation, postoperative care and advancements in anesthesia. The greatest single factor influencing mortality, however, is earlier operation and operation on a decreasing number of complicated cases. During the period from 1912 to 1945, the operative mortality was 0.9 per cent, the lowest observed in any period. It is of interest to note that this earlier diagnosis is probably reflected in the incidence of discovered common duct stones. In the first two periods, 1910 to 1933 inclusive, stones were found in about half of the common ducts explored. From 1934 through 1945 stones were found in the common ducts in one third of the ducts explored and during the last period, 37 per cent of ducts explored were found to contain stones, with an operative mortality decreasing to less than 1 per cent. It is also evident that many more common ducts must be explored than

contain stones if we are to avoid overlooking stones in the common duct. We have, however, not found that exploration of the common duct in which no common duct stones are found increases in any way the operative morbidity or mortality.

### SUMMARY

It is well recognized that gallstones occur in 10 to 20 per cent of individuals past 30 years of age. They are more common in women than in men—in our experience this proportion is 3 females to 1 male.

Surgical treatment of gallstones should be instituted early and in the majority of cases. Operative interference may be contraindicated in the exceptional case owing to age, serious debility or other organic disease.

Complications of neglected disease of the gallbladder include acute gallbladder, common duct stones, jaundice, pancreatitis, hepatitis, malignancy, spontaneous fistula and intestinal obstruction.

Common duct stones are found in 15 to 16 per cent of patients operated on for stones in the gallbladder.

The mortality of gallbladder surgery over the period 1942 to 1945 inclusive was 0.9 per cent, a notable decrease to that of earlier years—4.7 per cent.

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## THE ACUTE GALLBLADDER

SAMUEL F. MARSHALL AND E. S. PHILLIPS

ACUTE conditions of the gallbladder should very properly be assigned to the group of acute abdominal emergencies, and surgical treatment should be undertaken as early as consistent with the patient's general condition.

In this paper we are reporting a series of 74 patients with acute gallbladders, submitted to operation and the diagnosis established by careful pathologic examination of the removed specimens. In this group there were 47 females and 27 males, which is about the usual incidence of gallstones in women and men.

Table 1 lists the various age groups noted in this series which also closely parallels occurrence of gallstones at various age levels. It is of interest to note that 28, or 38 per cent, were 60 years of age or over.

TABLE 1  
DISTRIBUTION ACCORDING TO AGE

Age, years	Number
20-29	1
30-39	9
40-49	17
50-59	19
60 and over	28
Total	74

In 1923, Walton of England proposed operation early after the onset of the disease process and thereby precipitated a more or less controversial discussion of the surgical management as relates to the optimal time for surgical intervention. In 1930, in this country, many surgeons questioned the advisability of this method of surgical treatment and by 1933 many papers appeared in the literature with proponents for both the immediate and delayed methods of surgical treatment.

Among those surgeons advocating delay in instituting surgery for the acute gallbladder were included Deaver, Haggard, M. K. Smith, Cave, Lyons, Lewis, Bass, Behrend, E. A. Graham and Bruggeman. In the opposite category favoring earlier operation, however, were many surgeons of equal prominence and experience, including Stone, Alexander, Estes, Eliason, Finney, H. F. Graham, Heuer, Judd and Phillips, Lund, Mentzer, Pratt, Miller, Royster, Heyd, Zininger and Leriche. All of the French school favored early operation, as did Kirschner alone in the German school. Statistics were cited to support both viewpoints; however, very often the definitions "early" and "immediate" operations had diverse meanings in the different series



and consequently permitted no comparison of surgical results. We believe that a more logical approach to the problem would be to define "early operation" so as to include those patients operated on within seventy-two hours of the onset of acute symptoms; "intermediate" after seventy-two hours to the complete cessation of clinical manifestations, and "late" as any time after the clinical remission of objective and subjective symptoms. We would prefer to regard all cases as abdominal emergencies, to admit all patients at once to the hospital, and as soon as the diagnosis can be established, the patient's general condition be evaluated and the chemical and fluid balance can be restored, to operate. These operations should very properly be listed as "early" surgical procedures. This should be the ideal method of treatment, wherein operation could be carried out before the development of marked inflammatory changes and before the development of serious complicating factors which so profoundly influence morbidity and mortality. Only 11 in this group of 74 patients were operated on during the first seventy-two hours, whereas 63 were admitted to the hospital and operated on an average of four to seven days after the onset of symptoms—much later than should ideally occur. Surgery in these late operations is more difficult technically, postoperative discomfort is increased and the hospital stay is prolonged in the majority of cases. It is also significant that 50 of this group of 74 patients gave a history of multiple attacks of gallstone colic prior to the acute process. In other words, had the diagnosis been established and operation instituted earlier, a larger majority could have been saved the distress and added risk of the complication of acute gallbladder.

It is encouraging to note the increasing preference for early operation among surgeons, and this preference now is almost universal. McGuigan alone of recent authors has counseled late operation. A thorough study of clinical manifestations in relation to pathologic changes has swung the pendulum. We favor the early operation. Mentzer, in 1932, stated that the ability to determine clinically the type or stage of acute cholecystic disease is not well developed and that though the operative mortality in advanced acute cholecystitis is great, it is considerably less than that which follows deferred or mistaken diagnosis. The inability to determine by any present-day clinical or laboratory methods the progress of the pathologic process has been emphasized repeatedly by Crile, Clagett, Bachhuber, Tournoff, Clute and Kenney, Heuer, Zininger, Heyd and Kunath. In Kunath's series of conservatively managed cases the process did not subside clinically in 32 per cent and the patients were of necessity operated on during the intermediate period. Zininger found that in only 37 per cent the process subsided, whereas in 27 per cent the patients showed progressive changes. Tournoff determined that 20 per cent of his patients with little or no symptoms had progressive lesions. A careful study of our series of 74 pathologically proven cases

of acute cholecystitis and of their clinical manifestations confirms this conclusion of the unpredictability of clinical signs and laboratory findings in estimating the degree of inflammatory change.

Furthermore, the inability to follow the pathologic process accurately by clinical means is illustrated by the fact that perforation occurs in from 6.82 per cent (Bachhuber) to 13 per cent (Clagett) and to 20 per cent in the large collected series reported by Heuer. Perforation has an average reported mortality of about 45 per cent. This does not include other immediate or subsequent sequelae of a perforated viscus. There were nine perforations among the 74 cases herein reported. One patient was operated on the fourth day after the onset of symptoms, 2 on the sixth, 2 on the eighth, and others after a longer interval. Three patients had some type of postoperative complication—one formed a persistent sinus tract, another had pneumonia and developed a hernia, and the third had a wound infection. There were no deaths in this group of 9 cases of perforated gallbladders. There was but one death in the series of 74 cases, which represents a consecutive series of all types of acute cases and not a selected group.

The highest mortality still remains in the older age group who have concomitant organic disease. In Bachhuber's series, 69.23 per cent were over 63 years of age and almost all had had repeated attacks as well as concurrent disease. M. K. Smith stated that the fatalities are confined to the older age group and that peritonitis is not so frequently a cause as suspected. Eliason and Stevens found the mortality after 60 to be eight to ten times greater than that before 60 years of age; they also discount the factor of infection as a contraindication for early operation. Bachhuber best summarized the situation when he wrote, "for the more recurrent attacks the patient has, the older the age, the more likely it is that the patient may also be suffering from some serious concomitant disease all of which contributes to the mortality."

The *modus operandi* of the pathologic process in acute cholecystitis is not clearly understood. Denton in 1927 advanced the theory that since the veins and lymphatics are more intimately associated with the cystic duct, the impaction of a large stone in the cystic duct closes off the veins and lymphatics before the artery, to cause intramural edema and venous distention. This theory has been questioned by Kreider who, by injection studies, demonstrated that an impacted stone by direct pressure cannot cause venous stasis, for the rich venous anastomoses adequately carry off the blood. Saint, however, postulated that it is an obstructive phenomenon occasioned either by a stone or inflammation or both which by exudation and transudation increases the intravesical pressure which most commonly may cause tension gangrene at the fundus. Five of our 74 patients did not have stones and 12 had but one stone. Andrews, who made serial section studies of the acute gallbladder, found a definite correlation of the condition of

the cystic duct with the pathologic changes in the gallbladder. He found the changes to be most marked in the fundus; patchy necrosis was seen more often on the hepatic than on the free peritoneal edge, and the edema was characteristically almost solely in the subserous layer. With regard to bacterial infection Andrews found that whereas in the quiescent cases 8 per cent gave high colony counts, only 6 per cent of the acute cases yielded high colony counts on culture. These cultural studies led him to the conclusion that infection plays a very minor role. Therefore, although the exact pathophysiology has not been discerned, the facts known and corroborated indicate an element of obstruction with venous distention and an outpouring of lymph into the subserous space.

Although cholecystectomy is the operation of choice and was done in 73 of the 74 cases, cholecystostomy should not be deprecated as it may be the first stage of a life-saving procedure, particularly in elderly patients or those in poor physical condition. One must realize that often the mortality and morbidity assigned to cholecystostomy reside in the fact that this operation has been employed to rescue the patient who has progressed unfavorably under the so-called conservative regimen of treatment. Since it is technically easier to accomplish, it may be the operation of choice because of obesity of the patient, poor illumination, inadequate anesthesia, or lack of assistance when sufficient exposure cannot be obtained. It will accomplish the relief of obstruction, and it is reported that in about 80 per cent of cases the patients remain symptom-free subsequently. In this series there was but one cholecystostomy. This was considered justifiable and indicated as the cholecystostomy was performed eighteen days after the acute onset of symptoms. A second operation was then performed seventy-eight days subsequent to the first procedure. At this time cholecystectomy and choledochostomy were done. From a pathologic standpoint the gallbladder was reported as acutely inflamed, with areas of ulceration and necrosis. Stones were also found in the common duct.

Stones in the common duct are more often an accompanying feature of acute cholecystitis than is generally thought. Thirty-five of the 74 patients whose cases are herein reported had common duct explorations. Stones were found in 12 cases. This is an incidence of 16.2 per cent which very closely parallels the occurrence of common duct stones in the chronic calculous gallbladder. In a series of 1101 such cases in this clinic<sup>1</sup> from 1912 to 1915 inclusive the incidence of common duct stone was 16.8 per cent. Common duct stones should be searched for just as carefully in the acute gallbladder as in the chronic uninfamed gallbladder and will just as frequently be found.

Cholecystectomy was accomplished in 73 cases. In 51 cases, however, the operating surgeon elected to do the dissection from the fundus to the cystic duct instead of carrying out a retrograde dissec-

tion as is the usual method in this clinic. The marked edema makes this method of dissection easier and safer in most cases, since it permits easier visualization of the cystic artery, cystic duct and also common duct which may be obscured by the marked edema which often involves the tissues over the common duct to a marked degree. Of the 11 patients operated on within forty-eight hours of the onset of symptoms, 5 had dissections from the fundus to the cystic duct and 6 in the retrograde manner.

It is well also to consider the influence of sulfonamide and antibiotic therapy in morbidity and mortality in the treatment of acute gallbladder. Undoubtedly these therapeutic agents will aid in reducing mortality and possibly favorably affect the course of the disease. In the large majority of these cases reported the patients did not have the benefit of such therapy and although there was one postoperative mortality in this small series, yet postoperative discomfort and the period of hospital confinement were increased. It is also conceded that the complication of acute inflammations of the calculous gallbladder has serious potentialities, especially in the aged or in individuals who have other serious organic disease. Perhaps these valuable therapeutic agents will in many instances affect the time of surgical intervention but undoubtedly if the acute gallbladder were considered and treated as any other acute abdominal emergency, morbidity and operative risk could be kept at a minimum. These therapeutic agents are by no means a substitute for urgent surgery.

#### SUMMARY

We have reported a consecutive series of 74 pathologically proven cases of acute disease of the gallbladder, with one postoperative death, a mortality of 1.3 per cent.

Acute cholecystitis is an acute surgical condition in which early operation, preferably within forty-eight hours after the onset of symptoms, permits a more thorough operation at less expenditure of time, money and suffering on the part of the patient as well as reduction in the operative risk. Because of the relatively high incidence of common duct stones, they should be carefully sought for and removed in the acute gallbladder as in other cases of disease of the gallbladder. Cholecystostomy has a limited indication in the treatment of acute cholecystitis but is a valuable surgical procedure in some cases. Early operation should reduce the mortality in the older age group as it lessens the hazards of depleted reserves in cases of concomitant disease. In an editorial entitled, "Acute cholecystitis—why delay," C. G. Heyd wrote, "The indication is to operate carefully with due celerity, relieve the mechanical obstruction, and provide drainage. Teachers of surgery who lend their prestige and give support to a policy of waiting provide authority for timid surgeons, inexperienced operators, and procrastinating practitioners."

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## CHOLEDOCHOSTOMY; ITS PLACE IN SURGERY OF THE BILIARY TRACT

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IN our experience, the mortality in biliary tract surgery is closely related to the incidence of common duct stone and the delayed treatment of gallstones. This is particularly true if those patients undergoing reconstructive operations on the common bile duct for the relief of stricture are eliminated. In an analysis<sup>2</sup> of 3,373 patients with disease of the gallbladder, of whom 479 were found to have common duct stones, Cattell found 31 deaths or approximately one third of the operative deaths, occurred in patients with common duct stone.

Furthermore, there is no group of symptoms or physical signs either before or at the time of operation which will definitely exclude the presence of a common duct stone in a patient with disease of the biliary tract. This means that the advisability of exploring the common duct for common duct stone must be carefully considered in every patient operated on for cholelithiasis. If the history, physical examination, and operative findings are carefully reviewed and evaluated with this in mind, fewer common duct stones will be left behind, and the overall mortality of surgical procedures on the biliary tract will continue to decrease.

Just as there is no group of symptoms which will rule out a stone in the common duct, so there is no positive sign that a stone is definitely present in the common duct. Certain symptoms, such as jaundice, are so frequently the result of stones in the common duct that when jaundice is present one instantly thinks of this possibility. Yet if the surgeon carrying out surgical procedures on the biliary tract limits his indications for exploring the common duct to the presence of jaundice, he will leave behind almost as many common duct stones as he removes. In a recent review<sup>1</sup> of 1104 patients operated on at the clinic for cholelithiasis, 47 per cent of those patients who had stones in the common duct did not have jaundice.

There are a number of signs and symptoms which, if present in patients being operated upon for cholelithiasis, should suggest to the operating surgeon the advisability of exploring the common duct. In an early review of patients undergoing cholecystectomy at the clinic, a number of patients was found who had recurrence of symptoms owing to common duct stone and the over-all incidence of common duct stone at that time was 8 per cent.<sup>3</sup> At the present time we explore the common duct in 45.7 per cent of all patients with cholelithiasis, and the incidence of common duct stone has risen to 16.8 per cent. This means that the indications for exploring the common duct were increased. It also means that, if the number of common duct



stones left behind is to be reduced, many patients will have an exploration of the common duct in whom no stones will be found. From an experience of over 1500 explorations of the common duct, we are *firmly convinced* that exploration of the common duct in the hands of surgeons capable of doing such surgery does not increase the operative mortality or appreciably increase the operative morbidity. The routine use of spinal anesthesia in operations on the biliary tract, by facilitating adequate exposure, has been an important factor in the steady reduction of the associated mortality. The mortality in the recent review previously referred to was 0.9 per cent.

#### INDICATIONS FOR EXPLORATION OF THE COMMON BILE DUCT

1. **Jaundice.**—This includes not only the actual presence of clinical jaundice or the past history of jaundice, but also laboratory evidence of subclinical jaundice. In the 1104 cases of cholelithiasis recently reviewed, 18.1 per cent either were jaundiced or had a history of jaundice. The presence or a history of jaundice is a positive indication for exploration of the common duct in these patients, even though in this group of patients 52.5 per cent of those with jaundice or a history of jaundice did not have a stone in the common duct. In many of these patients, a recent decrease in the degree of jaundice and a dilated common duct with no remaining cause for dilatation suggested the recent *passage of a common duct stone into the duodenum*.

In these patients, also, carcinoma of the head of the pancreas or ampulla of Vater must be considered as a possible cause for the presence of jaundice. Anorexia, loss of weight, diarrhea (interference with pancreatic secretion) and intestinal bleeding (carcinoma of the *ampulla*) *should make the surgeon suspect that the obstruction to the common duct and the resulting jaundice may be the result of malignant disease and not of calculi*. We have repeatedly been impressed with the clinical value of Courvoisier's law in making this differential diagnosis.<sup>4</sup> If a suspicion of malignant disease is heightened by the *finding of a distended gallbladder, it is wise to palpate the head of the pancreas and the region of the ampulla carefully before proceeding with the proposed cholecystectomy*. If a tumor of the head of the pancreas or ampulla is found, and no stones can be palpated in the dilated common duct, the choledochostomy may be omitted and the gallbladder utilized to form a *cholecystojejunostomy*, either as a palliative procedure for the relief of the jaundice and its associated pruritus, or as the first stage of a pancreatoduodenectomy, depending upon the extent of the malignant process. It should be emphasized that jaundice associated with carcinoma of the head of the pancreas is not always painless. *Although typical gallbladder colic is uncommon, pain in the upper part of the abdomen is often an early symptom in this disease, and usually occurs at some time during its course.*<sup>6</sup> In one review of 46 patients with jaundice caused by carcinoma of the

head of the pancreas, pain preceded the jaundice in 16 cases, and followed the onset of the jaundice in 15 cases. Just as carcinoma of the pancreas is not always associated with painless jaundice, calculi of the common duct producing jaundice are not always associated with severe pain. Many surgeons and pathologists have removed a large, jaundice-producing stone from the common duct in a patient who had had an erroneous diagnosis of carcinoma of the head of the pancreas because of the relative absence of pain in the history.

A small group of patients who are not clinically jaundiced may show laboratory evidence of partial obstruction of the common bile duct. The normal value of serum bilirubin is from 0.2 to 0.3 mg. per 100 cc. A concentration of 0.7 mg. is necessary for the recognition of jaundice in the sclerae, and usually about 1 mg. for recognition of jaundice in the patient's skin. Therefore, a serum bilirubin of 0.5 to 0.7 should suggest the advisability of exploring the common duct.

Although the presence or history of jaundice is a positive indication for exploration of the common duct in patients with gallbladder disease, the converse is not true. In the 1104 patients previously referred to, 47 per cent of those who were found to have stones in their common ducts did not have jaundice. This means that in almost half of the entire group in which common duct stones were found, some indication other than jaundice prompted the exploration of the common duct.

**2. Dilated or Thickened Common Duct.**—If the gastrohepatic omentum is incised to permit adequate exposure of the junction between the cystic and common ducts which is an essential part of any cholecystectomy, the size of the common duct can be accurately determined. Since the majority of patients with common duct stone have some degree of dilatation of the common duct, a duct having a larger diameter than normal should be explored for the presence of stone. If a stone is not found it may mean that a common duct stone has been present and has passed into the duodenum. A dilated duct containing no stone may be secondary to obstruction caused by carcinoma in the head of the pancreas or the ampulla of Vater, or it may simply be the physiologic dilatation which occurs when the cystic duct is obstructed or when the gallbladder is removed.

A thickened common duct wall such as is associated with cholangitis or long-standing chronic inflammation of the gallbladder is an indication for exploration of the duct and the establishment of adequate drainage both into the duodenum and to the exterior. A history of intermittent chills and fever, although not found in a high percentage of patients with common duct stone in our experience (5 per cent), may form an additional reason for exploration and drainage of the common duct in patients of this type.

**3. Small Stones in the Gallbladder.**—Probably most stones found in the common and hepatic bile ducts have originated there as a result of disturbed metabolism, or infection secondary to a diseased

gallbladder.<sup>7</sup> Nevertheless, most surgeons operating on the biliary tract have many times found small stones in a perfectly normal appearing common duct, which are identical in size and shape to stones which they have just removed with the gallbladder. If the cystic duct is patent, it is possible that such small stones in the gallbladder may pass through the cystic duct into the common duct either before or during the operative procedure. Therefore, we regard small calculi in the gallbladder of a size capable of passing through the existing cystic duct, as an indication for exploration of the common duct. For the same reason, when carcinoma of the head of the pancreas has been ruled out, and the necessity of preserving the gallbladder eliminated, the gallbladder and its stones are removed before the common duct is explored. Otherwise the manipulation of the gallbladder during its removal may force stones down into the previously cleared common duct. If for some reason the common duct is to be explored first, and the gallbladder contains stones, the cystic duct should be occluded immediately following the clearing of the common duct.

It may be argued that such small stones, if they do get into the common duct, should pass on into the duodenum without difficulty. They may do so, but if they do not, the patient will continue to have symptoms, and will have to be operated on again, with the inevitable increase in morbidity and mortality which attends secondary operations on the biliary tract. The objective of the surgeon operating for cholelithiasis should be to leave the entire biliary tract free of calculi, in so far as it is possible to do so.

**4. Positive or Suspicious Findings on Palpation.**—If the gastro-hepatic omentum is incised and the fat and areolar tissue reflected from the anterior surface of the common duct, satisfactory palpation of the common duct can be carried out by placing the first two fingers of the left hand in the foramen of Winslow and compressing the common duct between the thumb and fingers. Stones of moderate size or larger can often be detected in this manner. Even suspicious findings should call for exploration of the duct. Two facts should be kept in mind, however, in connection with palpation of the common duct for stone. In the first place, negative findings on palpation are no guarantee that stones are not present, for small stones in the common duct often cannot be detected by palpation. In the second place, lymph nodes lying behind the duct may simulate calculi, and careful palpation will be required to determine that these small palpable nodules are not actually within the duct and are of a different consistency from stones. If there is any question in the operator's mind, it is wise to open the common duct, pass a sound down the duct into the duodenum and then palpate the suspicious nodule against the instrument.

**5. Sediment in Bile Aspirated from the Common Duct.**—Frequently an indication of the condition of the common duct can be obtained by aspiration of bile from the common duct with a small

syringe and a hypodermic needle. If the bile is dark and contains sediment, the duct should be opened, the patency of the sphincter of Oddi established, and the duct washed clean. At times the lower end of the common duct may be so filled with detritus and sediment that the sphincter is practically occluded even though no actual stone is present. If considerable detritus and sediment are found in the gallbladder, the duct should be aspirated, and if the aspirated material differs from the clear golden yellow bile, normal for bile in the common duct, choledochostomy is indicated.

**6. Acute or Subacute Pancreatitis.**—If the diagnosis of acute pancreatitis can be definitely established, the patient should be treated conservatively and operation avoided. Sometimes, however, the diagnosis cannot be definitely established, and since acute cholecystitis or perforated peptic ulcer may be present, laparotomy may be necessary. At other times, when the abdomen is opened for cholelithiasis, an unsuspected acute or subacute pancreatitis may be present also. In these patients drainage of the common duct should be considered carefully. In the first place cholangitis or inflammation of the large bile ducts is often associated with pancreatitis. At times a common duct stone blocking the ampulla has been considered a precipitating cause of the pancreatitis. In the second place, choledochostomy represents the most satisfactory means of draining the inflamed area in these patients. It is a much more direct approach than is drainage of the gallbladder, and is a safer procedure than the now seldom used incision and drainage of the pancreas itself. The latter procedure should be used only in the rare patient in whom the disease process has gone on to actual suppuration. When choledochostomy is carried out for pancreatitis, drainage should be prolonged and the T tube is left in place for weeks or months.

**7. Noncalculus Gallbladder with Biliary Tract Symptoms.**—Occasionally, a patient may be operated on for cholelithiasis, in whom the gallbladder is found to contain no stones. If that patient has a history of biliary colic and other biliary tract symptoms, the possibility of the disease being within the common duct must be carefully considered. A stone originating in the common duct may be responsible for the patient's symptoms, or a calculus may have recently passed through the cystic duct into the common duct and may still be present.

### TECHNIC

A safe and thorough exploration of the common duct can be carried out through the same exposure which we believe is an essential part of a safe and thorough extirpation of a gallbladder and its cystic duct. The incision in the gastrohepatic omentum and subsequent dissection which is carried out to visualize the junction of the cystic and common ducts for the cholecystectomy is extended to expose the anterior surface of the common duct below the entrance of the cystic duct. The

common duct can be much more effectively explored through a longitudinal incision in the anterior wall of the common duct at this point than through the cystic duct stump, and the procedure is not associated with any increase in morbidity or complications. Even if the cystic duct is large enough to admit forceps, dilators and scoops, the flange presented by the cephalad angle of the junction of the two ducts makes exploration of the hepatic ducts unsatisfactory.

If the suction tip is held close to the point of incision when the duct is opened, very little bile will be spilled, and a gauze sponge previously placed down to the foramen of Winslow will absorb any blood or bile which might escape during the procedure. Long Allis-type clamps, the teeth of which have been filed down, are placed on the cut edges to spread them and permit adequate exploration of the duct in both directions. They permit more control of the opening in the duct than do silk guy sutures which are frequently used for this purpose. The importance of an adequate exposure of the duct and its contents can be appreciated from some of the statistics on overlooked stones reported in the literature. Young found that in the postmortem examination of patients who had been operated on for choledocholithiasis, stones had been left behind in 16.4 per cent of the cases. Mayo reported that in the postmortem examination of patients who died following operations for stones of the common duct, stones had been left behind in a third of the cases, and Pribram concluded that stones were left behind in 16 to 25 per cent of all patients operated on for choledocholithiasis even by experienced surgeons.

The common and hepatic ducts are first carefully explored by means of scoops and forceps until one is satisfied that they are clear. The ampulla is then carefully dilated by graduated Bakes dilators to a size corresponding to the size of the duct. No force should be used in passing these dilators into the duodenum. Once the precise direction and angulation has been determined by passing the smallest sound into the bowel, the succeeding dilators can be molded to this curve and, if passed in a similar manner, will slip into the duodenum with very little pressure. Following this, any remaining debris or calculi are washed into the bowel by saline irrigations of the duct through a catheter. Cholangiography is not used in the operating room. This procedure prolongs the operating time, the films are subject to misinterpretation and, in our opinion, would seldom reveal a stone small enough to escape the careful search described previously. It is true that stones can become so imbedded in crypts in the region of the ampulla that scoops and sounds may pass by them into the duodenum, but such stones would also be particularly difficult to pick up by cholangiogram. Many such stones will become dislodged as the ampulla is dilated during the course of the exploration.

After the ducts have been cleared, the opening in the common duct is closed tightly about a T tube, bringing the long arm out the upper

end of the incision in the duct well away from the duodenum. Like Gray, we prefer a T tube to a catheter, because it will stay in place as long as it is needed, and because it affords better control of the drainage of bile. The tube is clamped for one hour on the seventh post-operative day, and this period of clamping is increased each day. In the average patient it is removed as soon as the stools become well colored, about the twelfth postoperative day. In patients with marked dilatation of the biliary tract, drainage is often continued for three months and if a severe degree of cholangitis is present, for as long as six months. These patients keep the tube clamped off and coiled in their dressing while they are up and about during the day, and allow it to drain freely into a bottle at the side of the bed at night. If the duct contained many stones, a cholangiogram is often done before the tube is removed to make certain that a stone has not been overlooked or has been passed down from the intrahepatic biliary tract subsequent to exploration. Following removal of the T tube biliary drainage usually ceases within a few hours. We have seen no complications which could be attributed to trauma associated with the removal of these tubes.

### CONCLUSIONS

The advisability of exploring the common bile duct should be considered in every patient who has a cholecystectomy. It should be carried out if any one of a number of indications is present. Stones in the common bile duct will be overlooked, and the morbidity and mortality of surgical procedures on the biliary tract increased if jaundice is used as the sole criterion for exploring the common bile duct.

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## INJURIES TO THE BILE DUCTS

FRANK H. LAHEY

THE fact that we have operated upon 202 patients with strictures of the bile ducts is evidence that this is a not uncommon lesion.

Injuries to the common and hepatic bile ducts usually can be attributed to one of four factors: poor anesthesia with inadequate relaxation; incisions of inadequate length with which to obtain good exposure; failure to have learned that common and hepatic duct exposures can be obtained only by putting those structures on the stretch so that they stand out as cords and, finally, the presence of atypical anatomy of the ducts, the hepatic artery or the cystic artery.

I know of no surgery which can be simpler in one case or more complex in another than that associated with cholecystectomy. In those patients with long, thin abdomens, with long liver edges which can be pulled down and rotated, with gallbladders with long mesenteries attaching them to the under surface of the liver and with anatomical relations that are normal, the removal of the gallbladder can be almost literally like picking a pear in a case in which the cystic duct enters the common duct at a relatively low level. The very next case in which this operation is undertaken can be the exact reverse even though it is not associated with an acute or subacute cholecystitis. All of the above desirable conditions may be absent. The abdomen may be short and thick, the abdominal wall fat, the liver not easily mobilized with no overhanging shelflike edge, the entrance of the cystic duct into the common duct high in the hilum of the liver, the gallbladder itself intrahepatic in location, and the anatomy atypical both as to ducts and blood supply—that is, the relationship of the hepatic and cystic arteries to the neck of the gallbladder.

It is in these latter cases that the accidents in cholecystectomy occur and the injuries to the common and hepatic ducts result. If all surgeons would adhere to a few basic rules, there would be many fewer bile duct injuries than there are now and will be in the future unless these warnings are heeded.

When one adds to the above difficult situation the presence of an acute or a subacute cholecystitis, the situation becomes more complicated and capable of resulting even more frequently in surgical accidents to the common and hepatic ducts. Even the first type of case which, when unassociated with an inflammatory process, is as simple as picking a pear, can become difficult and dangerous if an acute inflammatory process is present, particularly when the tissues at the junction of the cystic, common and hepatic ducts must be dealt with in the presence of an indurative inflammatory exudate. It is in these



cases, particularly, *that the common and hepatic ducts are in danger of being injured.*

### PREVENTION OF BILE DUCT INJURIES

I know of no situation in abdominal surgery where good exposure is more important than in the cholecystectomies in which the potentially dangerous anatomical design at the duct junction which must be dealt with is in such a deep hole and is associated so precariously with the possibility of hemorrhage from a vessel, the hepatic or cystic arteries. These arteries may bleed so profusely and in such amounts that blood accumulates at the bottom of this deep hole in such a manner as to make demonstration of the source of the bleeding and control of the bleeding point extremely difficult unless the special measure by which it can be done is known to the operator.

The two types of anesthesia which will produce the type of relaxation so badly needed in operations done at the depths required for so many cholecystectomies are spinal anesthesia and any of the general anesthetics combined with curare.

The difference of a few inches in the length of an abdominal incision may make a great deal of difference in the ease of the exposure of a region as deep as the common and hepatic ducts and their junction where the cystic artery must be ligated. It is for that reason that we would strongly urge that gallbladder incisions be adequate, that the criticism if anything be that they be too long rather than too short. With the present methods of suture of the abdominal wall, a difference of 3 to 4 inches plays relatively little part in the incidence of incisional hernias and can make a great difference in the ease and safety of the operation.

Whether one employs a right rectus, a longitudinal or the transverse incision is, in our opinion, relatively unimportant. Relaxation, good light, the method of rotating the duodenum to the left and the liver to the right to put the ducts on the stretch, and a dry field are the important factors in exposure which will avoid the accidents that occur as a result of lack of these aids and result in injuries to the common and hepatic ducts.

There have been various proposals made as to how the common and hepatic ducts may best be exposed. No method of exposure of the ducts is of value without good anesthesia, good relaxation, the wide exposures obtained with long incisions, a dry field and good light.

Many of the proposals of the past to facilitate the exposure of the common and hepatic ducts have been related to the introduction of pads, inflatable bags beneath the back, and a breaking table, with the idea that these steps would bring the duct nearer to the surface and thus make it easier to deal with. All of these methods are completely valueless in terms of greater ease of exposure of the bile ducts.

Exposure of the common and hepatic bile ducts is based upon the

single fact that these ducts in a natural state are loose, relaxed, and the foramen of Winslow is collapsed. The main bile ducts attached at one end to the hilum of the liver and the other to the duodenum can be put on the stretch so that they are visualized and the opening into the foramen of Winslow made to gape widely. This occurs when the ducts are put upon the stretch by traction to the right on the upper end of the duct at its point of entrance into the liver, and traction to the left on the lower end of the duct at its point of entrance into the duodenum.

This traction can be obtained by introducing wet pads over the duodenum and the hepatic flexure and retracting those two structures to the left, and by introducing a pad over the under surface of the right lobe of the liver and retracting that structure to the right. With this type of exposure the following anatomical parts, if it is properly done, immediately become visible. The anterior surface of the kidney covered by the parietal peritoneum can be seen; the descending portion of the duodenum can be visualized; the foramen of Winslow gapes open widely, and the vena cava which marks its posterior boundary in patients who are not too fat can be seen as a large blue tube. The common and hepatic ducts stand out at the anterior boundary of the foramen of Winslow; the junction of the cystic duct with the common and hepatic ducts can be plainly seen; the hepatic artery running behind or in front of the cystic duct and sending its cystic artery branch to the gallbladder can be seen when these structures are not anomalous.

It is an established rule in this clinic that no cholecystectomy shall ever be done either when the cholecystectomy is approached from below upward, as it is in the noninflammatory case which can be well visualized, or from above downward, as it is in the inflammatory case which cannot be well visualized and also in those cases in which the entrance of the cystic duct into the common and hepatic ducts is high, at the level of the hilum of the liver. It is the regular custom here in all patients with acute or subacute cholecystitis submitted to cholecystectomy in this clinic to remove the gallbladder from above downward. In no patient is a cholecystectomy ever done until the cystic artery has been demonstrated, clamped and cut.

One of the causes of hemorrhage from the cystic artery in cholecystectomy, and one not appreciated by many, is traction by the operator upon the ampulla of the gallbladder or upon the gallbladder itself after it has been freed from its bed in the liver. The traction will not be upon the cystic duct but upon the cystic artery. When the cystic artery tears, as it not infrequently will when this traction upon the artery is made, it will tear at its point of origin from the hepatic artery, resulting in very profuse bleeding because of the size of the hepatic artery and the vigorous character of the bleeding which comes from it. It is to be remembered that the cystic artery is often a relatively short structure, while the cystic duct is long, lax and often convoluted. It is for this reason that we would like to urge strongly that the rule

which we have observed here for many years be universally applied, namely, that *no cholecystectomy* be done until the cystic artery has been found, isolated, clamped and cut.

When the above procedure has been employed, one can then accurately dissect out the junction of the cystic artery, the common and the hepatic ducts, and this will avoid the injuries which so often result when hemorrhage from either the cystic artery or the hepatic artery has occurred.

It is as important for me to discuss here how to avoid injuries to the common and hepatic ducts as to discuss what to do with them when they have occurred, because avoidance is easier and better than repair.

I wish particularly to warn against a quite commonly employed method of doing cholecystectomies and that is the placing of a single clamp on the cystic duct so as to include the cystic artery. As shown in Figure 181, not infrequently as one pulls upon the gallbladder, traction upon the cystic artery will so angulate the hepatic artery that as the clamp is placed upon the neck of the gallbladder it will include, as shown in the figure, the angulated hepatic artery. This places the artery under tension so that, as the tie is placed about the neck of the artery (see the figure), there is a tendency particularly for the upper arterial end to retract out of the ligature and result in a serious hemorrhage.

Hemorrhage is the most common cause of injury particularly to the hepatic duct. In writing upon this subject we have frequently stated that the histories of the majority of the patients who come to us for repair of injuries to their bile ducts usually contain evidence that during the cholecystectomy serious hemorrhages occurred which were often controlled with great difficulty and ultimately only by applying a clamp which was left in place or was put on blindly many times in desperation.

If one will refer to Figure 181, it will be seen that when bleeding from a torn cystic artery or hepatic artery is controlled by the blind application of a clamp, the clamp is bound to include the hepatic duct, and it is this type of injury that so often results in stricture, particularly of the hepatic duct.

There is a simple procedure used by us for many years, and frequently described, which is very satisfactory and successful in the management of a torn cystic or hepatic artery. There should never be any great alarm should either artery get loose. One has only to introduce the index finger into the foramen of Winslow and the thumb over the hepatic artery, to pinch between the two and control bleeding completely. The exposure can then be improved, the clot wiped out completely and the field made dry, the finger pressure released and the bleeding point visualized. This can be repeated, with the blood wiped dry, until the bleeding point can be accurately picked up so that one can, under direct vision, be sure that there is no injury to the duct,

tied either with silk or cotton, and one does not need to worry then about duct injury.

The second type of duct injury which occurs is largely related to removals of the gallbladder when done by freeing the gallbladder from

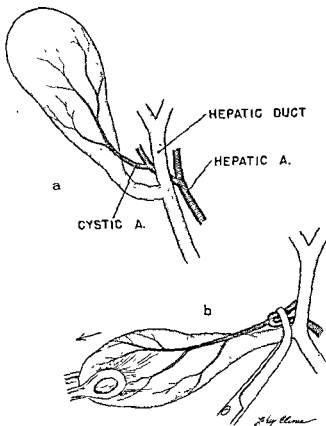


Fig. 181.—In *a* is shown the anatomical relationship between the cystic duct, cystic artery and right hepatic artery.

In *b* is shown the angulation of the right hepatic artery as traction is made upon the gallbladder and how, when a clamp is applied to include both duct and artery, the right hepatic artery can be included. In this illustration the artery is shown coming from behind.

above downward so that it hangs by the cystic duct. It is also related to the failure to isolate the cystic artery so that it can be cut, clamped and tied as an individual structure instead of applying a clamp to the cystic duct that includes the artery. This plan of cholecystectomy not only makes it possible, as shown in Figure 181, to include a section of

the hepatic artery but in those patients with lax common and hepatic ducts there can be such traction on the common and hepatic ducts at the point where the cystic duct enters that the right-angle clamp applied here, unless all of the anatomical field has been properly dissected out, can include a section of the common and hepatic ducts. In this case, when the gallbladder is cut away, a section of the common and hepatic duct is cut away also. This results in the complete loss of a section of the common and hepatic ducts so that there will frequently be a gap of 1, 2 or 3 inches between the ends as a result of loss of duct structure.

Still another, but much less common, type of injury to the common duct which can result in stricturing is mutilation of the duct in the process of exploring it for stones.

If common ducts are put on the stretch by the maneuver of traction to the right of the liver and traction to the left of the duodenum, the incision into the duct for exploration for stones will be much simpler and safer than if attempts are made to open ducts when in their natural relaxed and limp state. All incisions for exploration for common duct stones should be in a longitudinal direction and at a little distance below the level where the cystic duct enters the common duct. *Exploration of the common duct for stones should almost never be attempted through the cystic duct.* To attempt exploration through the cystic duct generally means that the exploration cannot be adequate because of the limited caliber of many of the cystic ducts. There is the additional disadvantage that the cystic duct enters the common duct in an oblique manner and this makes attempts to insert scoops into the hepatic duct at times quite difficult, whereas if the incision is made lower in the common duct, scoops can be passed up into the hepatic duct more readily without the obstruction met by the overhanging lip made at the point of entrance of the cystic duct. Great care should be exercised in handling the edges of the incision in the common duct. *If silk guide sutures are employed, very gentle traction must be made upon them or they will tear out and result in loss of structure and substance of the walls of the hepatic duct.* We have employed tacking forceps of the Allis type with a long handle and with jaws from which all teeth have been removed.

It is needless to say that incisions in the common or hepatic ducts should never be made in the oblique or transverse manner.

#### TREATMENT OF ESTABLISHED INJURIES

There are three types of injury of the bile ducts to be dealt with: the type which is the result of a crush, the type due to removals of sections of the duct, and the type due to fibrosis or erosive injury to the sphincter of Oddi by erosion of a stone.

The first type of injury to the common duct, so frequently brought about by the blind application of a clamp following hemorrhage from

the cystic or hepatic artery, is the crush injury. This type of stricture has been found in many of our cases and can frequently either be excised and remedied by end-to-end anastomosis, or incised and remedied by the Heineke-Mikulicz principle.

The second type of injury is that in which complete loss of substance of the duct has occurred as a result of the removal of a section of the duct of greater or lesser length. Dr. R. B. Cattell and I very soon will publish a method of repair of this type of stricture which we have developed in this experience with 202 cases of stricture of the bile ducts by means of which the lower end of the common duct is found, freed and mobilized by rotating the duodenum, by splitting the portion of the head of the pancreas that passes behind the duodenum and presents on this right margin of the duodenum, and by mobilizing the head of the duodenum so that the two ends of the duct can be brought together, regardless of how great the defect.

The ideal time to repair a stricture of the bile duct is as soon after the injury as the condition can be approached. It is at this time that structures are still flexible and scar tissue has not involved the important structures in this region, such as the duct ends, the hepatic artery and the portal vein. It is at this time that the lower end of the common duct behind the duodenum and in the head of the pancreas can be mobilized while it is still flexible, and brought up to be anastomosed to the cut end of the duct. It is at this time that scarring in the hilum of the liver has not occurred to involve the hepatic duct, the veins and the artery, and it is at this time at the first attempted repair of the injury, either of the crush type or of the type in which a section of the duct is removed, that there is the best opportunity to obtain successful and lasting good results.

We have repeatedly written that as each attempt is made to repair the injured bile ducts and results unsuccessfully, each time there will be a loss of substance in the ducts themselves which will make the next operation more difficult and less likely to result in an outcome which will be satisfactory and lasting. I have personally written and stated that if those who are experienced in the management of duct injuries, and there are many, could have them to repair soon after the original injury, a much higher percentage of satisfactory and lasting results could be obtained.

By the plan, which Dr. Cattell and I will shortly publish, of finding the lower end of the common duct which, because of its location within the head of the pancreas and behind the duodenum, is protected from injury, a very large number of strictures can be repaired by an accurate end-to-end anastomosis so that mucosa goes to mucosa and stricture does not again result. By this plan the undesirable feature which may accompany the implantation of tubes by other methods employed up to the present, and which still must be employed in some of the cases—namely, plugging—can be avoided.

*In these cases it is to be noted that when end-to-end anastomoses are done a T-tube is inserted not through the suture line but through an incision made below the suture line, the upper limb of the T-tube being passed through the suture line to maintain patency until accurate healing has taken place. When the T-tube is placed through the suture line and later withdrawn there will be left a definite defect in the duct which can be replaced only by scarring and which will unavoidably result in some degree of duct narrowing. When a T-tube is placed through an incision below the suture line this will not occur and accurate healing of the end-to-end anastomosis with complete mucosal replacement can take place. It has been our custom to leave these T-tubes in place when end-to-end anastomosis of the ducts is done, for a period varying from six months to a year, in order to be sure that molding, absorption of scar and mucosal replacement take place.*

There will be cases in which there has been so much loss of duct as a result of previous operations—and many of the patients upon whom we have operated for common and hepatic duct strictures have had three, four and even five unsuccessful previous attempts at repair—that it will be necessary to introduce tubes. In some of these cases repeated unsuccessful repair operations will have so destroyed the upper end of the hepatic duct that there will be no remaining single structure of that duct. In such cases one can only find the divided hepatic ducts as they exist intrahepatically. In these cases one can only introduce the Y type of tube, using vitallium, rubber or bouncing clay, the material which we have described and which has been made available to us by the research department of the General Electric Company in Schenectady, putting the Y in the intrahepatic ducts and the single limb in the demonstrated common duct.

Whenever tube implantations are made in place of end-to-end anastomosis, one must realize that the prospects of lasting success are uncertain. In a certain number of these cases the tubes, whatever type may be employed, will quite frequently plug because of the inspissated bile and bile salts lodging in them, and require replacement. Because of this it is our attitude that whenever possible we prefer end-to-end anastomosis to the employment of indwelling tubes of any type.

In the article to be published on this new method of dealing with strictures of the duct, the plan of finding the lower end of the common duct and mobilizing it will be illustrated and described. As the result of our experience with it, we believe that there are many patients who are now being treated by tube implantation in whom, by this plan, a good common duct can be found and the head of the pancreas so mobilized that easy approximation of the two ducts can be accomplished with accurate end-to-end anastomosis.

I feel very strongly that one very serious mistake has been made in our consideration of the method of dealing with strictures and injuries

to the bile ducts by the implantation of tubes. We have assumed that vitallium, because of its tissue tolerance, has an advantage over other types of material. The advantage of any material of a tube type which is implanted in the place of a bile duct lies only in its propensity not to plug. From our experience, there is no difference whatever in the likelihood of plugging when one employs rubber, vitallium or bouncing clay.

There is a final, rare type of duct stricture which is the result either of fibrosis of the sphincter of Oddi or fibrosis at this level as a result of ulceration of a stone lodged at the lower end of the common duct into the duodenum. These lesions are the type which result in inadequate drainage of the bile duct into the duodenum, the occurrence of bile stasis and the formation of a common duct stone at the lower end of the bile duct. These are the cases in which repeated reformation of common duct stones occurs following their removal.

We have dealt with this type of case by longitudinal incision of the duodenum over the point where the common duct enters the duodenum at the papilla. A small probe has been inserted into the papilla which has been demonstrated by injection of salt solution through a tube inserted into the lower end of the common duct at the point where it runs through the duodenal wall into the duodenum. The sphincter has been incised and the edges of the duct have then been sutured to the duodenal mucosa. A T-tube with long ends has been inserted into the common duct so that one end projects into the duodenum. The patients have worn these tubes for a year until the reconstructed lower end of the duodenum has become well healed and molded, at which time they have been removed, with maintenance of a free flow of bile into the duodenum, and in these cases there has been no further formation of recurrent common duct stones.

Injuries to the bile ducts, other than those which are man made, are extremely rare. When they do occur from other than operative causes they are usually associated with traumatic lesions of such severity and magnitude as to make the survival of the patient problematical. Any injury of such character as to tear off the common duct could hardly fail to do serious damage to other important neighboring structures. That a fatality in such cases, however, may not necessarily occur is demonstrated by the fact that we have had one stricture of the common duct following an automobile accident, in which the duct was injured behind the duodenum. This was successfully managed surgically, with survival of the patient and maintenance of good function over several years.

Surgical injuries to the common duct are avoidable lesions. They are not only avoidable but with reasonable precaution they are quite readily avoidable. They are accidents of such a serious character, occurring in patients who would otherwise be well throughout their



lives, that, when doing cholecystectomy, one should always realize that this disastrous calamity constantly stares one in the face and that the adherence to the few simple rules stated above, particularly that of finding, demonstrating, clamping and severing the cystic artery before the cholecystectomy is performed, will reliably protect the surgeon and the patient from this lamentable accident.

# THE USE OF A LONG T-TUBE IN SURGERY OF THE BILIARY TRACT

RICHARD B. CATTELL

OBSTRUCTION of the biliary ducts is a common finding during surgery of the biliary tract. Calculi are the usual cause of this obstruction but less frequently benign stricture or malignancy is responsible for the obstruction. Exploration of the extrabiliary ducts, usually through the common duct, is necessary in a considerable number of patients operated on for gallstones. In a recent survey<sup>1</sup> of patients operated on for gallstones at the Lahey Clinic, the common duct was explored and drained in 504 patients of a total number of 1104 patients, an incidence of 45.7 per cent (Table 1). It will be seen from this Table

TABLE 1  
GALLBLADDER OPERATIONS

Years	Gallbladder Patients	Common Duct Exploration		Common Duct Stones		Operative Mortality	
		Cases	Per cent	Cases	Per cent	Cases	Per cent
1930-1933	493	198	40.2	98	20.0	11	2.2
1934-1937	634	284	44.8	103	16.2	20	3.1
1938-1941	909	444	48.8	123	14.1	21	2.3
1942-1945	1104	504	45.7	186	16.8	10	0.9

that common duct exploration is considered necessary in nearly one half of the patients operated on for gallstones in this clinic. This can be contrasted with an earlier experience reported by the author<sup>2</sup> twenty years ago when only 15 per cent of patients had common duct exploration.

It is a common surgical practice to drain the common duct by a catheter or T-tube. In this clinic we utilize a T-tube in all cases, and have experienced little difficulty with its removal. In only one out of over 2000 patients having T-tube drainage was any difficulty experienced in its removal. In this one patient, the T-tube broke off 2 cm. above the transverse limb, and was removed by reopening the wound. The common duct incision may be closed primarily by suture without the utilization of a tube, but this method has no particular advantages.

Some patients are not relieved by clearing the duct system of sediment, sand and stones because obstruction at the papilla of Vater is not relieved. Under these circumstances, when the gallbladder has previously been removed, the formation of stones within the biliary ducts can be proved. Approximately 4 per cent of the patients having

common duct stones do not have stones in their gallbladder, which offers further evidence of their formation within the duct.

When forcible dilatation of the sphincter of Oddi and papilla of Vater is necessary, it is always accompanied by submucosal hemorrhage and edema. This may be followed later by fibrosis, resulting in the same or greater degree of narrowing than originally was present. Relief of the back pressure of bile by means of a T-tube during this period of mechanical and inflammatory swelling at the papilla is generally accepted as the best means of avoiding difficulty but may not be a sufficient safeguard against its recurrence.

In all instances of common duct exploration the entrance of the common duct into the duodenum should be carefully explored to determine its patency or degree of narrowing. Gentle dilatation of the papilla by means of graded sounds, such as the Bakes dilators, will provide information as to the size of the opening. When the duct opening does not permit the passage of a probe, either because of narrowing or an *angulated course*, it may be necessary to open the duodenum and dilate it or cut the sphincter of Oddi under direct vision.

Under both of these circumstances, first, when forcible dilatation of the ampulla is performed or second, when the sphincter has been divided by transduodenal exploration, it is best to have an indwelling tube or mold through the traumatized area of the papilla for varying lengths of time, depending on the disease present. A long catheter passed distally through the duct can be used, but a T-tube with a long horizontal limb, permitting direct passage of bile into the duodenum is greatly to be preferred.

Ten years ago, a T-tube with a long horizontal limb was devised to answer this problem. Since that time it has found many satisfactory uses in biliary tract surgery, some of which have previously been presented.<sup>2</sup>

### THE LONG T-TUBE

The conventional T-tube has a  $4\frac{1}{2}$  inch transverse limb. The long T-tube has a 12 inch horizontal limb, which is the approximate length of the vertical portion. The T-tube has been made of the usual red rubber, also of pure gum and synthetic rubber.\* The original long T-tube described by the author had horizontal limbs of unequal lengths—2 inches and 4 inches. Because of a problem in manufacture it was easier to join two equal lengths of tubing at the mid portion of one, making each end 6 inches. This is the type that has been used for several years. The proximal end can be cut to whatever length is needed. The synthetic rubber tubes are the most practical since they are somewhat rigid and are passed more easily through the ampulla. Sizes 12, 14, 16 and 18 are available (Fig. 182). The lumen of these tubes is sufficiently large to permit the free flow of bile into the duodenum.

\* These tubes are manufactured by the Davol Rubber Company, Providence, Rhode Island.

Theoretical objections to placing a tube through the ampulla for varying periods of time must be considered. Reflux of duodenal content into the biliary duct system is a possibility. A large experience with the use of a long T-tube through the papilla has failed to demonstrate the occurrence of this possible complication. With the long T-tube through the papilla if barium is given by mouth, reflux within the duct system

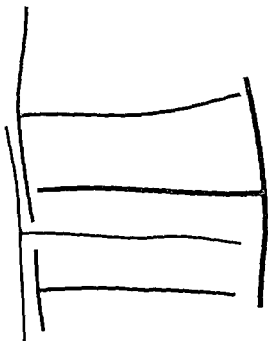


Fig 182.—Long T-tubes, sizes 12, 14 and 18 For comparison the conventional T-tube is shown below.

is rarely observed. Patients with a long T-tube in place do not have attacks of cholangitis even though the tube is left in place for a year or more. Cholangitis may be considered to have taken place when transient jaundice has occurred but can be shown to be due to obstruction by sediment. The greater pressure within the biliary tract is probably sufficient to protect against reflux of the duodenal contents. Furthermore, the fact that the end of the T-tube within the duodenum passes close to the ligament of Treitz makes reflux less likely.

Exploration of the common duct should not be attempted through the cystic duct stump since it is impractical to probe the proximal duct system and it permits only demonstration of patency of the duct and the papilla. A generous incision should be made in the common duct

itself, usually just distal to the entrance to the cystic duct. It is preferable to have the lower end of the incision stop at least 1 cm. away from the edge of the duodenum. With probes, stone forceps and scoops, the patency of the duct is demonstrated and stones removed. If one fails to

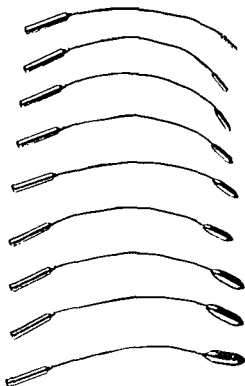


Fig 183.—Graduated Bakes dilators. These have flexible shafts so that the curves can be adjusted for convenience. They are most useful in probing and dilating the ampulla.

pass a probe through the papilla, it is well to incise the peritoneum on the right of the duodenum, turning over the duodenum and raising the head of the pancreas. This may permit probing through the papilla when it was not possible previously, by straightening out the common duct. Dilatation with the Bakes dilators up to size 8 or 9 (Fig. 183) usually can be accomplished without undue difficulty and with minimal trauma.

If patency of the papilla cannot be demonstrated by means of probes, it is necessary to open the duodenum. With elevation of the duodenum and head of the pancreas, the papilla can frequently be palpated directly by pressing the mesenteric surface of the duodenum against the head of the pancreas. A longitudinal incision in the duodenum should be made well down in the second portion of the duodenum (Fig. 184). The posterior wall of the duodenum may be visualized and ele-

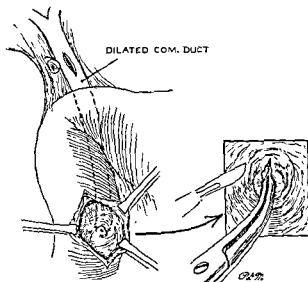


Fig. 184.—Diagram illustrating transduodenal division and dilatation of the sphincter of Oddi. The gallbladder has been removed and the cystic duct tied. An incision has been made in the common duct but a probe failed to pass through the ampulla into the duodenum. A longitudinal incision on the anterior wall of the second portion of the duodenum is shown, exposing the papilla.

The inset shows division of the sphincter of Oddi following which dilatation with a clamp or with the Bakes dilators is performed.

vated by means of Allis clamps, bringing the ampullar region into view. A probe can then be passed down the common duct through the choledochostomy incision to the papilla, which can then be incised, permitting passage of the probe. This can be followed by dilatation with the Bakes dilators from above downward under direct vision, or a right angle clamp can be put into the opening of the common duct and the sphincter of Oddi directly incised under vision (Fig. 184). A uterine probe or small Bakes dilator can then be passed through the papilla into the common duct and a long limb of the T-tube anchored on the probe and drawn through the papilla (Fig. 185). To avoid narrowing

itself, usually just distal to the entrance to the cystic duct. It is preferable to have the lower end of the incision stop at least 1 cm. away from the edge of the duodenum. With probes, stone forceps and scoops, the patency of the duct is demonstrated and stones removed. If one fails to

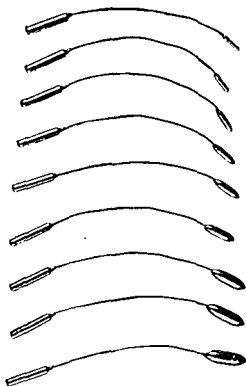


Fig 183.—Graduated Bakes dilators. These have flexible shafts so that the curves can be adjusted for convenience. They are most useful in probing and dilating the ampulla.

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If a long T-tube has been employed it requires care to avoid incrustations and blocking of the tube. Clamping of the vertical limb of the T-tube is not necessary except as a convenience during the time the patient is ambulatory. Even when the tube is not clamped, the bile



Fig 186 —Cholangiogram of a size 14 long T-tube. Moderate blunting of the intrahepatic biliary ducts remains as demonstrated with injection of lipiodol. The distal limb passes through the ampulla and can be seen within the lumen of the duodenum.

passes directly into the intestinal tract, with only a small amount of bile being discharged through the vertical limb. The tube should be irrigated twice a day after the first week postoperatively for the entire time that it is left in place. It can be permitted to drain at night during the hospital stay but need not be left open subsequent to this period. During the immediate postoperative period alimentation can be carried out with normal saline or 5 per cent glucose solution unless a severe degree of cholangitis is present. In this way, intravenous fluids may not be necessary. In addition to irrigation, a cholagogue or cholanteric in the form of decholin or bile salts should be given.



of the duodenum, the duodenal incision can be closed transversely (Fig. 185).

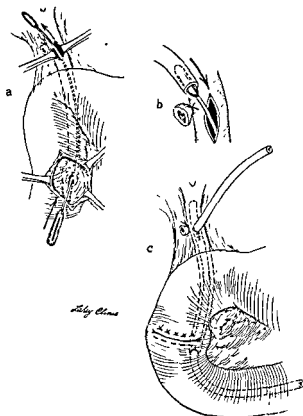


Fig 185.—*a*, A size 4 Bakes dilator has been passed through the dilated papilla and emerges from the opening in the common bile duct.

*b*, The long limb of the T-tube has been inserted over the probe for ease in drawing it through the papilla of Vater.

*c*, The long T-tube is now in place. The incision in the common duct has been closed and the incision on the anterior wall of the duodenum has been closed transversely. This tube will be left in for a minimum of six months.

Failure to pass a probe through the papilla of Vater during common duct exploration will usually result in subsequent obstructive symptoms, making secondary operation on the ducts mandatory. We have had a number of experiences of this type so that it has been necessary to resort to transduodenal exploration in a number of cases to avoid this postoperative complication.

place for a minimum of six months and frequently for twelve months. In our experience, some of these patients have had multiple operations on the biliary tract without relief of symptoms, and the good results following the employment of the long T-tube are very gratifying.

**3. Repair of Benign Strictures.**—Successful repair of benign strictures is dependent upon accurate anastomosis of the proximal and distal portions of the duct system. The results following such repair are much better in our experience than after anastomosis of the proximal duct to some portion of the gastrointestinal tract. In view of the fact that the ampulla has been functionless during the duration of the stricture, it may become narrowed and fibrosed. Even with dilatation it may be necessary to have a mold not only through the repair of the strictured area but also through the duct entrance into the duodenum. We have had several patients in whom incrustations have developed in the conventional short T-tube or plugging of other indwelling tubes, such as vitallium, rubber or bouncing clay, accompanied by stone formation proximal to the indwelling tube. If the long T-tube can be employed in end-to-end duct repair of the stricture, bringing the vertical limb through a normal portion of the duct either proximal or distal to the anastomosis, and with the long horizontal limb passing through the duodenum, this incrustation or stone formation may be avoided. Such a T-tube should be left in place for a minimum of one year or longer, continuing irrigations throughout the entire period.

**4. Malignancy of the Bile Ducts.**—Malignancy at the lower end of the common duct is best treated by radical pancreatoduodenal resection, with anastomosis of the proximal duct to the jejunum. Occasionally, carcinoma is encountered within the hepatic ducts or common duct that cannot be resected because of extension. Under these circumstances we have employed the long T-tube after dilatation of the malignant area to maintain an open passage through the malignancy so that bile passes directly into the duodenum. While the results are discouraging in these cases, at least it serves during the short period of life to relieve the jaundice without the production of an external biliary fistula, with resultant loss of bile. Even advanced cases involving the gastrohepatic omentum may be treated in this fashion, although the relief is quite temporary.

**5. Resection for Duodenal Ulcer.**—The long T-tube may be quite useful in certain gastroduodenal resections for duodenal ulcers. The largest group of patients with duodenal ulcers requiring surgical intervention are those in whom the ulcers are penetrating or perforating into the pancreas in the posterior portion of the first and upper second portion of the duodenum. Before resection can be demonstrated to be feasible and safe in an appreciable number of these, the common duct should be identified, opened and its intrapancreatic course determined. Implantation of the long T-tube permits careful dissection of the duodenum and its later closure without interference with the lumen of the

The time of removal of the long T-tube is determined by the pathologic change present at the time of operation. Rarely will it be removed in less than one to two months and frequently it is left in place for six, twelve or eighteen months. Irrigations of the T-tube are continued twice a day during this period. Visualization of the biliary tract by injection of a radiopaque solution is not necessary (Fig. 186) and is not effective since the material will pass directly into the duodenum. It will, however, demonstrate incrustation of proximal or distal limbs. Removal of the long T-tube is no more difficult than removal of one with a short limb. After removal, irrespective of the length of time it has been in place, drainage of bile from the wound ceases within a few hours.

#### INDICATIONS FOR THE USE OF THE LONG T-TUBE

**1. Recurrent Common Duct Stones.**—Stones may be found in the common bile ducts following previous operations on the biliary tract. The number of these cases will be in proportion to the frequency of common duct exploration at the original procedure. While stones may be left in the hepatic ducts where they have floated back in the bile, they are usually encountered in the ampullar region. From the physical characteristics of these stones, most of them unquestionably have formed in the gallbladder and have been left in the duct system. Others unquestionably form in the duct itself and in these circumstances some degree of obstruction in the distal duct can be demonstrated. Recexploration of the duct must be done in these cases and the long T-tube is particularly useful. The stones are cleared from the duct system and the papilla dilated if probes can be readily passed through. Repeated irrigations of the proximal duct system will get rid of sediment and sand. Small stones or fragments of stones will be pushed through the dilated ampulla by irrigation of the distal duct. If satisfactory dilatation of the ampulla cannot be effected, a transduodenal approach to the ampulla must be used. In all of these cases the long T-tube should be implanted and left in place for six to twelve months. During this time irrigation of the tube two or three times a day is important and will be helpful in clearing the intrahepatic radicles of sediment.

**2. Fibrosis of the Ampulla of Vater.**—While more patients are being found with symptoms persisting after cholecystectomy, or after cholecystectomy and choledochostomy, these symptoms may persist without jaundice due to narrowing in the region of the papilla of Vater. Diagnostic biliary drainage may show indifferent findings or may show bilirubin pigment and cholesterol crystals when stones are present. Many of the cases considered as biliary dyskinesia are in reality cases of organic obstruction in the ampullary region. Dilatation and implantation of the long T-tube with or without transduodenal exploration will relieve the symptoms in these cases. The T-tube should be left in

## TUMORS OF THE GALLBLADDER

NEIL W. SWINTON AND WALTER F. BECKER

TUMORS of the gallbladder may be benign or malignant. Both types are rare. Malignant tumors are the more important.

Primary carcinoma of the gallbladder is an uncommon disease. There have been 4,553 operations on the gallbladder performed at the Lahey Clinic. In this series 41 patients have been found to have primary carcinoma of the gallbladder, an incidence of 0.9 per cent. Seven additional patients were found to have benign tumors.

The purpose of this presentation is to review briefly the literature and to report this group of cases of gallbladder malignancy and benign tumors. The incidence, age and sex, relation of gallbladder malignancy to cholelithiasis, symptomatology, associated pathology, the histologic picture of this type of malignancy, treatment, and the end results of cancer of the gallbladder will be discussed. The group of benign tumors will be mentioned.

### MALIGNANT TUMORS

**Incidence.**—There is considerable discrepancy in the reported figures relative to the incidence of primary carcinoma of the gallbladder. Kaufman reported several years ago that approximately 5 per cent of all malignancies encountered at autopsy originated in the gallbladder. In a more recent article by Jankelson of a series of 11,400 consecutive autopsies, an incidence of only 0.27 per cent was reported. Mohardt, from a study of 35,000 collected gallbladder operations by different surgeons, reported an incidence of 1.12 per cent. As more and more patients are operated on for gallstones at an earlier age than was the case in the past and because certain other types of malignancy have shown an apparent increase in recent years, notably that of carcinoma of the lung, the incidence of carcinoma of the gallbladder at the present time is probably considerably less than 5 per cent.

Patients with primary carcinoma of the gallbladder have been reported as young as 23 years of age and as old as 90. The majority are between 50 and 70 years of age. In our series the youngest was 47 and the oldest 80, the average age incidence being 62.7 years. Eight patients in our group were between 75 and 80.

Carcinoma of the gallbladder is more common in women than in men, the ratio approximately 4 to 1. It has been estimated that between 8 and 10 per cent of all malignancy in women originates in the gallbladder. In our series 5 or 25 per cent were in males and 15 or 75 per cent in females.

**Relation of Gallbladder Malignancy to Cholelithiasis.**—The relation of cholelithiasis to carcinoma of the gallbladder is interesting because of the high incidence of gallstones in those patients with primary cancer of the gallbladder and because of the possible relation of

common duct. In these cases the T-tube may be removed safely within twelve to fourteen days.

6. **Duodenal Diverticulum.**—The same safety factor may be necessary in the resection of certain duodenal diverticula as for subtotal gastrectomy for duodenal ulcer. When they occur in the second portion of the duodenum their neck may be found near the course of the common bile duct. To be sure, these are few in number, but when there are symptoms demanding resection of a duodenal diverticulum in this area, it is quite helpful to know that the common duct is left intact by implanting a long T-tube through the papilla.

### SUMMARY

The uses of the long T-tube in surgery of the biliary tract have been presented. An increasing number of patients has been encountered in the past ten years with obstruction of the biliary duct persisting after previous operation. Such unsatisfactory results may be avoided by recognizing the additional pathologic change at the original operation and utilizing the long T-tube with the distal limb passing through the papilla into the duodenum. Reflux into the biliary duct system with accompanying cholangitis as evidenced by malaise, chills, fever and jaundice is rare and is no contraindication to the use of the long T-tube. Indications for the use of the long T-tube are outlined. It should be emphasized that the tube requires irrigations throughout the time that it remains in place. During the immediate postoperative period alimentation can be utilized, decreasing the amount of intravenous therapy.

Experiences over a ten-year period demonstrate that the results after biliary tract surgery may be improved by the use of the long T-tube in selected cases.

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**Relation of Gallbladder Malignancy to Cholelithiasis.**—The relation of cholelithiasis to carcinoma of the gallbladder is interesting because of the high incidence of gallstones in those patients with primary cancer of the gallbladder and because of the possible relation of

gallstones to the development of malignant disease of the gallbladder. Graham has reported that 8.5 per cent of all proven cases of cholelithiasis were associated with carcinoma of the gallbladder or bile ducts. Judd and Gray have stated that only 2 per cent of over 15,000 cases of cholelithiasis were associated with carcinoma of the gallbladder or bile ducts. Cole believes that the figures of 4 to 5 per cent arrived at by Mohardt after a careful review of the literature, represent a reasonably accurate estimate of the related incidence of carcinoma of the gallbladder to gallstones.

The incidence of gallstones in those patients with gallbladder malignancy is high. In the literature estimates of from 65 to 100 per cent are reported, the average being 76 to 87 per cent. In our series of 20 cases, 11 or 55 per cent were associated with cholelithiasis and one additional patient had cholesterolosis. Two of our patients had an associated ulcerative colitis and one a generalized polyposis of the colon, which were presumably incidental findings.

In the literature there is no unanimity of opinion concerning the advisability of *cholecystectomy* when gallstones are encountered because of the possibility of the development of subsequent malignancy.

The policy at this clinic has been to recommend *cholecystectomy* whenever gallstones are encountered in patients who are otherwise in reasonably good general condition with an appreciable life expectancy. This policy, however, is based more on the probability of the later development of symptoms from the gallstones, digestive or colic, than on the probability of the development of the rare case of primary carcinoma of the gallbladder. The association of gallstones and *cholecystitis* with cancer of the gallbladder has been quite universally accepted for a great many years. It is recognized that there may be a relation between the presence of cholelithiasis and chronic gallbladder infection and the development of gallbladder malignancy. It has been our experience that the mortality and morbidity from *cholecystectomy* for gallstones is less serious than the difficulties arising from long-standing disease of the gallbladder and biliary ducts.

**Symptoms.**—Unfortunately, there are no early symptoms characteristic of primary malignant disease of the gallbladder. The symptoms which are first encountered are usually those of the associated cholelithiasis and typical of that disease. In our series of patients, 18 complained of gastrointestinal symptoms which clinically could not be differentiated from chronic *cholecystitis* and cholelithiasis. Jaundice was encountered in 13 of our patients. In general, the obstructive type of jaundice associated with carcinoma of the gallbladder will be persistent and progressive as compared with the intermittent type so commonly encountered with *biliary tract lithiasis*. Twelve of our patients complained particularly of right upper quadrant or mid abdominal pain. This pain is more likely to be progressive than is the intermittent type of colicky pain encountered with cholelithiasis. In 10 of our cases an abdominal mass could be palpated when the patients

were first examined. The palpable tumor of malignancy may be firm and fixed, but these characteristics usually are not accurate criteria in making the diagnosis of malignancy except in the advanced cases. Ten of our patients complained of weight loss of varying amounts and 7 of acholic stools. The type of jaundice found in patients with primary carcinoma of the gallbladder is usually of the obstructive type but clinically this may be very difficult or impossible to distinguish from primary lesions in the head of the pancreas or ampulla of Vater.

**Histologic Picture.**—Ewing has classified carcinomas of the gallbladder microscopically as (1) adenocarcinoma; (2) alveolar carcinoma and (3) squamous cell carcinoma. The adenocarcinoma is the most frequent form; the squamous cell carcinoma the least frequent. He emphasized the early and rapid invasion of the gallbladder wall with extension into the liver or regional lymph nodes. He also pointed out that tumors of this type frequently arise in the proximal portion of the gallbladder or cystic duct and extend downward along the common duct. Because of this, at operation it frequently is impossible to determine whether the tumor arose in the gallbladder or the biliary ducts.

**Treatment.**—Because of the insidious onset and the early spread of this type of malignancy, treatment in general is very unsatisfactory. Gray and Sharp have reported that, in a series of 291 cases of carcinoma of the gallbladder, in 85 per cent the tumor had spread into the liver, regional lymph nodes or omentum at the time of operation. It is a common experience that a biopsy alone is the only procedure that can be undertaken when this condition is encountered. In our series biopsy alone was performed in 4 instances; cholecystectomy in 3; cholecystectomy and choledochostomy in 6; choledochostomy alone in 2; cholecystectomy and partial resection of the liver in 1; cholecystostomy alone in 1, and cholecystostomy and choledochostomy in 1. One patient found to have primary carcinoma of the gallbladder was moribund on admission and was not operated on. Another, who died ten days following ileostomy for ulcerative colitis, was found to have an incidental primary carcinoma of the gallbladder. In 2 of our patients, primary carcinoma of the gallbladder was discovered by the pathologist, the gallbladder having been removed for other conditions and the condition not suspected by the operating surgeon. It might be supposed that this occasional finding of an early primary malignant lesion of the gallbladder by the pathologist would afford a certain number of patients with a favorable prognosis. However, this is not the case. In our series, of the 2 patients found to have an early carcinoma of the gallbladder, 1 is alive and well at the end of five years but the other died of his disease in thirteen months.

**End Results.**—As may be surmised from the foregoing discussion, the prognosis in primary carcinoma of the gallbladder is extremely poor; in reports from the literature the five-year survival varied from 0 to 6 per cent.

Of our 20 patients of whom 19 were operated upon, 6 died before



leaving the hospital and 7 others did not survive the first twelve months following operation. Three additional patients died at intervals longer than one year following the operation. One patient is known to be alive and well, with no evidence of recurrence five years after operation. A second patient, operated on five months ago, had an extremely early carcinoma of the gallbladder which to date has shown no evidence of recurrence. An additional patient is believed to be alive and well without evidence of the disease four and one half years after operation, but it has not been possible to obtain recent, accurate follow-up data on her. Thus, our operative mortality has been 31 per cent for this condition and the five-year survival rate 5 per cent.

### BENIGN TUMORS

Benign tumors of the gallbladder are less common than the malignant variety. Adams has recently reported that only one benign tumor of the gallbladder was encountered in a series of 1036 cholecystectomies performed at this clinic. In the entire experience of the clinic only 7 cases have been found. Four of these were papillomas and three adenomas or mucosal polyps.

Benign tumors of the gallbladder are probably of little importance clinically. Gallbladder symptoms found in these patients are due to associated cholecystitis and other diseases. In our series 6 of the 7 patients had associated cholelithiasis. Benign tumors are usually encountered as an incidental finding in a gallbladder which has been surgically removed because of gallstones.

Occasionally, benign gallbladder tumors are demonstrated by radiograph. It has been the policy at the clinic that when a benign gallbladder tumor is demonstrated by cholecystography even in the presence of a normally functioning gallbladder, cholecystectomy should be advised.

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# CARCINOMA OF THE LIVER—PRIMARY AND SECONDARY

BENTLEY P. COLCOCK

WHEN carcinoma involves the liver, whether primarily or secondarily, it usually is considered to signify a hopeless prognosis for the patient. While this is true in most instances, it is not invariably so, for there is reason to believe that, under certain circumstances, a direct attack on the hepatic lesion may result in a cure for some of these patients.

## PRIMARY CARCINOMA OF THE LIVER

Primary carcinoma of the liver must be considered in the differential diagnosis of any patient who has an irregularly enlarged liver with no evidence of malignant disease elsewhere in the abdomen or pelvis. It is uncommon, although Warvi found 1,200 cases which had been studied up to 1944. In 1945 Webb found 12 cases of primary carcinoma of the liver in 1,817 consecutive autopsies, an incidence of 0.66 per cent. This is a higher incidence than had previously been reported in this country, but lower than that reported from China or Africa where primary carcinoma of the liver is much more common. Webb's cases were all in American Negroes. Strong and Pitts found an incidence of 7.19 per cent for primary carcinoma of the liver in autopsies carried out on Chinese coming from a certain province in South China, where a high percentage of the population is infected with intestinal parasites, chiefly liver flukes. In this same study of 1,828 autopsies there were only 2 cases of primary carcinoma of the liver in white patients, an incidence of 0.109 per cent.

Primary carcinoma of the liver may be divided into two main groups: hepatoma, in which the malignancy arises from the parenchymatous liver cell, and cholangioma, in which the malignancy arises from the intrahepatic biliary duct cell. Clinically, carcinoma of the liver manifests itself in two forms. The first and more common type is the multiple nodular form in which grayish, sometimes hemorrhagic or bile-stained malignant nodules are found scattered throughout both lobes of the liver, frequently involving the entire organ (Fig. 187). This is a highly malignant, rapidly growing form of the disease, and the histologic picture varies markedly, but in most instances reveals an undifferentiated, rapidly proliferating type of malignancy (Figs. 188 and 189). The second form that primary carcinoma of the liver may take is the primary massive malignant tumor, in which the growth usually is localized to a single large white or yellow friable mass, occasionally having smaller secondary growths grouped around it (Fig. 190). It may retain this form until it involves almost the entire lobe. Histologically, the malignant cells closely resemble normal hepatic cells.

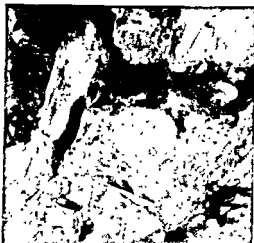


Fig. 187.—One of the many pearly gray nodules scattered throughout the liver substance.



Fig. 188 —Microscopic section of a rapidly growing anaplastic type of hepatoma ( $\times 100$ )

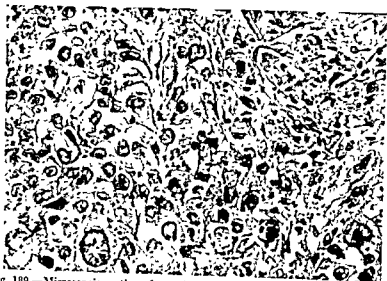


Fig. 189 —Microscopic section of a rapidly growing anaplastic type of hepatoma (×100).

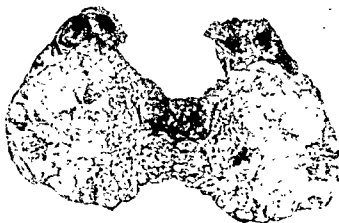


Fig. 190.—Large single type of hepatoma; no other visible or palpable neoplasms were found in the liver.

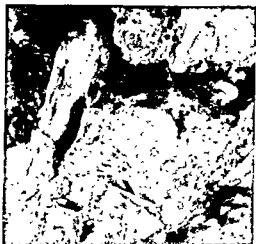


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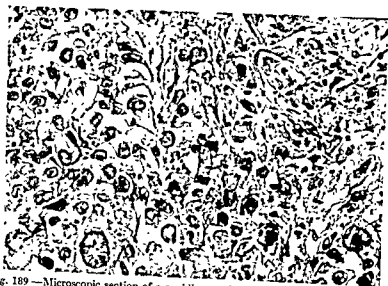


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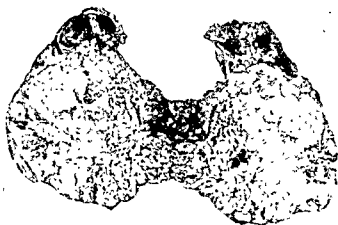


Fig. 190 —Large single type of hepatoma; no other visible or palpable neoplasms were found in the liver.

From the standpoint of etiology, the association with infestation of liver flukes is strongly suggestive of the important role played by chronic irritation. Ewing believed that cirrhosis of the liver is associated with 80 per cent of hepatomas and 50 per cent of cholangiomas. Webb felt that there is experimental evidence to show that dietary deficiencies are predisposing factors in explaining the racial and geographic variation in incidence.

The symptoms of primary carcinoma of the liver are similar to those of malignant disease elsewhere, namely loss of weight and strength, anorexia and secondary anemia. Epigastric or right upper quadrant distress is usually present, along with a palpable hepatic mass. Signs of malignant disease elsewhere in the abdomen or pelvis are absent. In the end stages jaundice or ascites may be present. By roentgenologic examination, the liver is fixed and enlarged, particularly upward.

Roentgen rays and radium are of no value in the treatment of primary carcinoma of the liver and the only hope is for those patients in whom the lesion is single and in whom resection can be carried out. In 1899 Keen resected a large carcinoma involving practically the entire left lobe of the liver; the patient had an uneventful convalescence. Brunschwig described an interesting case reported by Wendel of a large carcinoma involving most of the right lobe of the liver, which was resected along with the adherent gallbladder. Two years later the patient was again operated on for recurrence of the malignancy in the *nodes of the right retroperitoneal space*. Resection of the right colon with resection of the retroperitoneal lymphatic and areolar tissues was carried out and the patient survived seven years; he died nine years after his original operation from carcinomatosis, including involvement of the markedly hypertrophied left lobe of the liver. More recently, Wallace has collected 29 cases of resected hepatomas reported up to 1941. There were 23 survivals. Twelve were followed and of these, 5 patients lived over two years, 3 for three years, and 4 for more than five years.

## SECONDARY CARCINOMA OF THE LIVER

Secondary involvement of the liver by carcinoma occurs frequently in patients with carcinoma of the stomach, colon, pancreas, gallbladder, esophagus, uterus or ovary. It may occur by direct extension, as in some patients with carcinoma of the gallbladder, stomach or transverse colon. It may be involved by direct extension through the lymphatics from carcinoma of the colon or by embolic spread from the blood vessel invasion frequently associated with these tumors. It presents as one or more hard, raised, yellow-white nodules which, as they grow larger, degenerate in the center, and assume a characteristic umbilicated appearance. Occasionally they will not be found on the surface of the liver, but may be detected on palpation by their firm

consistency deep in the liver substance. This is particularly true when carcinoma occurs in the right lobe of the liver.

There are several points concerning metastatic carcinoma of the liver which the abdominal surgeon should keep in mind. It is important to realize that benign lesions of the liver may present a similar appearance to metastatic malignant lesions. This was illustrated by a patient recently operated on for benign disease of the pelvis. Routine exploration of the abdomen revealed a firm nodule, about 2 cm. in diameter, in the left lobe of the liver. When it was visualized it had the raised, whitish-yellow appearance typical of metastatic carcinoma of the liver. The segment containing the nodule was resected and proved to be a benign, calcified liver cyst. In spite of the fact that no primary site of malignant disease had been found elsewhere in the abdomen, only by pathologic examination of the liver nodule could a favorable prognosis have been given with assurance to this patient. Brunschwig has emphasized that frequently it is impossible to tell by inspection or palpation whether a solitary liver nodule is benign or malignant, and that the presence of one or several small subcapsular nodules in the liver when there is a resectable neoplasm within the abdomen should not deter removal of the latter because the nodules are assumed to be metastatic. He pointed out that not infrequently when such nodules are excised and examined histologically they are found to be fibromas, scirrhous angiomas or small cysts. Biopsy and frozen section should always be done if the nature of the operative procedure depends upon whether or not they are metastatic.

Brunschwig also emphasized a second important point which is often not fully appreciated, namely that when the liver is involved by direct extension from a carcinoma of the stomach or colon, the actual involvement of the liver is often less than it appears. He pointed out that the capsule (Glisson) of the liver is a fairly effective barrier to neoplastic infiltration from adjacent organs, and in most instances the apparent invasion is really only an adhesion to Glisson's capsule.

Because of the relatively long survival period found in patients with carcinoma of the colon and hepatic metastases, Wangenstein has suggested that when a single hepatic metastasis exists, it be excised at a second operative procedure, following the resection of the primary growth and the adjacent mesentery. Pointing out that Collier has demonstrated local invasion of the venous channels in 15 per cent of patients with carcinoma of the colon and rectum, and that the single hepatic metastasis may represent a single embolic spread, he believes that at times a two-stage procedure such as this may prove curative. In 1941, Cattell reported the successful resection of a large, apparently solitary metastasis, present in the right lobe of the liver in a patient, 70 years of age, with carcinoma of the rectum. The metastasis was excised at the first stage of a two-stage Lahey resection of the primary growth. The pathologic report on the resected sigmoid and rectum



was adenocarcinoma with no involvement of the mesenteric lymph nodes but with blood vessel invasion. This is suggestive that the hepatic metastasis was actually an embolic spread through the superior hemorrhoidal veins. This patient continued in his occupation as a caretaker for more than two years and died two and a half years after operation at the age of 73.

It is readily admitted that it is sometimes difficult to detect a metastasis deep in the right lobe of the liver, and thus, it is impossible to be certain that no other metastasis is present. Nevertheless, if resection of the hepatic metastasis is feasible, the patient is probably better off with a large focus of his malignant tumor removed. It should enhance the increased comfort which results from palliative resection of colonic and rectal growths even when such procedures do not actually prolong life.

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## INTRATHORACIC EXTENSION OF HEPATIC TUMORS

HERBERT D. ADAMS

SINCE it is a well established clinical observation that hepatic abscess may extend through the diaphragm into the thorax, it is readily conceivable that primary liver tumors may follow this same path of extension. This is probably, at best, an extremely rare occurrence especially as a clinical observation since hepatoma or primary carcinoma of the liver is rarely observed except at postmortem examination. This is owing to the lack of any characteristic symptomatology or accurate diagnostic measures and the highly malignant nature and rapid course of this disease. The diagnosis is, therefore, rarely made clinically and equally as rare are attempts at surgical extirpation.

In spite of these facts, however, in any obscure supradiaphragmatic or basilar intrathoracic disease, hepatoma with an intrathoracic extension must be considered. We have had 2 cases at the clinic presenting this clinical picture, in one of which this diagnosis was confirmed at operation and the other showed an interesting hepatic extension of a different nature.

The first patient was a 43-year-old, married, white woman who came in complaining of pain in the left shoulder of about three months' duration. The pain was of a constant and nonradiating nature. In addition, for about a month, she had also had a slightly productive cough, the sputum being occasionally streaked with blood; she had otherwise been well. With the exception of dullness and diminished breath sounds at the left base of the lung, her general examination was essentially negative and she appeared to be in good general condition. Roentgenologic examination at that time was interpreted as follows (Fig. 191): there was clouding at the left base apparently with a soft tissue mass just above the diaphragm which produced a depression on the air bubble of the fundus of the stomach, which indicated that the mass was fairly firm. The left diaphragm was elevated. The interpretation was: tumor of the left lung, probably malignant.

The patient was admitted to the hospital and bronchoscopy performed which revealed partial atelectasis of the left lower lobe with extrinsic pressure on the left lower lobe bronchus. No intrabronchial tumor was visible and no biopsy specimen was obtained. An exploratory thoracotomy, therefore, was done, and a dense, hard tumor mass was found which involved the left lower lobe, the lingula of the upper lobe and the diaphragm. Upon opening the diaphragm to note the extensions into the abdomen, the tumor was found also to involve the left lobe of the liver. A portion of the left lobe of the liver was resected, including a rather large portion of the diaphragm, the left lower lobe and lingula of the upper lobe of the lung. Even at operation, from the gross appearance of the tumor, it was thought that this was an unusual type of tumor but that it probably was either primary in the left lower lobe or the diaphragm.

The pathologist's report is given in some detail because of the unusual nature of this tumor. The specimen consisted of an irregular mass of tissue weighing

340 gm. It was made up of lung tissue, diaphragm and subdiaphragmatic tissue of a brownish type, resembling liver but considerably softer than usual, the central part of the specimen lying approximately in the plane of the diaphragm and involving the base of the lung, apparently penetrating through the diaphragm. The tumor mass cut with increased resistance and presented a light yellow, trabeculated surface which was coarsely granular and fibrillated, with areas of hemorrhage. The center of the lesion appeared to be necrotic and contained a small amount of pink purulent material. This central cavitation extended upward into the lung, but appeared to have no connection with the bronchial tree. The tumor tissue was clearly demarcated from the lung tissue but was not encapsulated. The

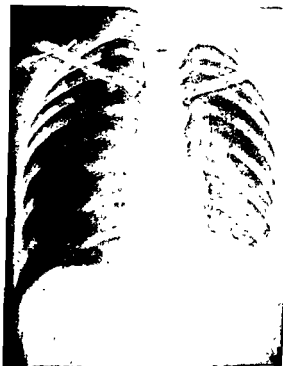


Fig. 191.—Hepatoma of the left lobe of the liver with intrathoracic extension. The left lower lobe was atelectatic. The tumor extended into what appeared to be the lingula of the upper lobe, although the interlobar fissure was indiscernible. The remaining lung parenchyma and bronchi appeared grossly negative. There was no connection with the tumor to any part of the bronchus. The final diagnosis was hepatoma arising from the left lobe of the liver.

The patient made a good convalescence and was discharged from the hospital eighteen days after operation.

This case is of extreme clinical interest since all the symptoms and

studies pointed toward a tumor of lung origin with extension through the diaphragm rather than a tumor primary in the liver and extending intrathoracically. There was one roentgenographic observation, however, which was definitely significant in attempting to establish the primary site of this lesion. The fact that the roentgenogram showed



Fig. 192.—Anteroposterior view showing intrathoracic extension of the right lobe of the liver due to eventration of the medial leaf of the diaphragm.

a soft tissue mass to produce a definite depression in the air bubble of the fundus of the stomach should lead one to the suspicion that the tumor probably arose in the stomach, spleen or left lobe of the liver rather than in the lung, producing such an extension. As has been stated in the article on subdiaphragmatic abscess, this same roentgenologic finding of a persistent depression in the air bubble of the fundus of the stomach is of considerable diagnostic significance in localizing a subdiaphragmatic abscess under the left diaphragm. I, therefore, wish to point out that this roentgenologic finding is of considerable diagnostic value in these problems.

The second patient was a man of 63 years who had a history of cough, sputum and hemoptysis and slight dyspnea on exertion. Roentgenograms of the chest showed a rounded mass of soft tissue density in the anterior portion of the right chest which appeared to be continuous with the diaphragm (Figs. 192 and 193). The lungs were slightly emphysematous and there were a few areas of calcification throughout the right mid lung field. The findings suggested either a hernia through the foramen of Morgagni or a pleural cyst. A bronchoscopy was essentially negative except for mucopurulent secretion, but all bronchial orifices could be seen and were open. A bronchogram done at this time showed a slight cylindrical dilatation



Fig. 193 —Same case as shown in Figure 192, lateral view

of the basal bronchi and the interpretation was minimal bronchiectasis. Gastrointestinal studies gave negative results; there was no evidence that any portion of the intestinal tract was involved in the mass in the anterior portion of the right lower chest (Figs. 192 and 193).

Although the pulmonary symptoms could be due to the minimal bronchiectasis, it was thought that since it was impossible definitely to establish the diagnosis with reference to the mass in the right lower chest, a thoracotomy was indicated. This was, therefore, done. The right pleural space was obliterated with numerous

old, dense, vascular adhesions. The right middle lobe of the lung was adherent to the mass in the region of the diaphragm anteriorly and medially and was partially atelectatic. Further dissection in this area showed the mass to be a localized eventration of the diaphragm with a rounded tumor of liver tissue arising from the right lobe of the liver, protruding high into the thorax but still covered with a thin atrophic diaphragm. This projecting mass, however, consisted of normal liver tissue. This liver tissue was depressed below the level of the normal dome of the diaphragm and the medial leaf was plicated to overcome this central eventration.

Following this procedure, the patient made an uneventful convalescence and was discharged from the hospital two weeks following operation.

This case illustrates another type of extension of the liver into the thorax, again with symptoms primarily of a thoracic nature but in which all possible studies were inconclusive so far as establishing a definite diagnosis. The roentgenologic interpretation, however, suggested the possibility of a hernia through the foramen of Morgagni; although this is a fairly common type of diaphragmatic herniation, it does not primarily contain liver tissue.

These 2 cases, therefore, represent very interesting extensions of the liver into the thorax, one being of a benign nature and the other being a highly malignant extension involving the lung. It is interesting to note that in both cases the symptoms were primarily of thoracic origin, but all studies were inconclusive and exploratory thoracotomy was necessary to establish the diagnosis. It is also of great interest to note that it was possible technically to remove the extensive hepatoma involving the left lobe of the liver, diaphragm, left lower lobe of the lung and lingula of the left upper lobe. In view of the highly malignant nature of hepatoma, however, the prognosis in this particular case is extremely unfavorable.



# THE SURGICAL MANAGEMENT OF PERIHEPATIC AND SUBDIAPHRAGMATIC ABSCESS

HERBERT D. ADAMS

LIKE many other types of extension or residual infection complicating a primary focus of infection, the incidence of subdiaphragmatic abscess has been materially reduced by the widespread use of sulfonamides, penicillin and streptomycin. Subdiaphragmatic abscess, however, has not been eliminated entirely by chemotherapy. It is also important to point out that in some instances the use of antibiotics has

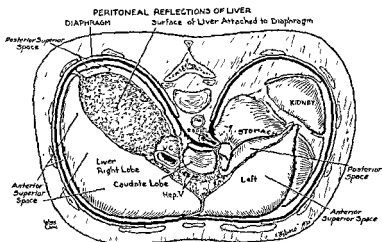


Fig. 194 — Anatomical relationships of subdiaphragmatic liver spaces.

obscured the true status and progress of the abscess, just as it may in empyema, and has led to further more serious complications. Since this disease still exists, even though at present greatly reduced in frequency, it is well to review the present status of its management and treatment.

Infection beneath the diaphragm, or in relationship to the several surfaces of the liver (Fig. 194), is most commonly a postoperative complication following many types of abdominal surgery. Such infection has been especially associated with the peritoneal contamination from appendicitis, perforated peptic ulcer, penetrating wounds of the abdomen and gastrointestinal resections. In fact, almost any type of abdominal or retroperitoneal operation may give rise to a complicating subdiaphragmatic infection. In the postoperative period clinical signs of an obscure infection may develop and when the more common sources of such an infection, such as residual abscess in the



field of operation, in the wound, in the urinary tract or the respiratory system, have been ruled out, attention must be focused on the subdiaphragmatic region for a possible extension or residual infection (Figs. 195 and 196).

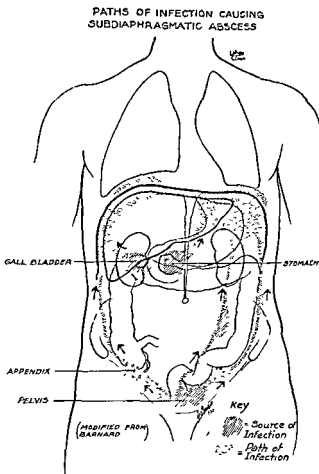


Fig. 195.—Paths of infection causing subdiaphragmatic abscess

Such an extension of infection to the subdiaphragmatic space must be visualized as varying considerably in degree, ranging from a mild diffuse cellulitis to frank suppuration and abscess formation. The former type of infection, although potentially serious, may subside under conservative measures and leave no residual abscess requiring

surgical drainage. A true abscess or multiple abscess confined to the subdiaphragmatic spaces, however, will menace the patient's life unless effectively localized and drained. At this point it is well to remember that, if a definite abscess has developed, one cannot rely on

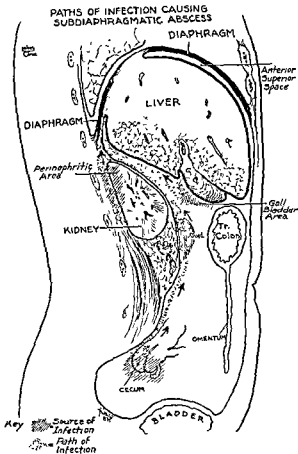


Fig 196 —Paths of infection causing subdiaphragmatic abscess, sagittal section.

chemotherapy for a cure, or to eliminate the need for drainage, in every instance. Under intensive chemotherapy there may be an apparent improvement, evidenced by a lowered temperature and leukocytosis, thereby completely overshadowing an almost imperceptible but steady decline in the general health of the patient. This may continue for many weeks, masking the true course of the infection, until suddenly the abscess ruptures through the diaphragm into the thorax, establishing widespread pleural contamination or even commonly a bronchial

*communication with rapid, widespread intrapulmonary infection.* This is, indeed, a critical complication in an already debilitated patient which should be avoided, but if it occurs, it requires immediate, wide drainage above and below the diaphragm to save the patient. On the other hand, if the abscess is properly localized and adequately drained, the prognosis will be good and the incidence of serious complications and mortality will be very low.

### DIAGNOSIS AND LOCALIZATION

The most important factor, therefore, is the exact localization of such an abscess. Physical signs and roentgenologic findings are often *minimal and confusing*. Frequently it is possible to localize the infection to this general region, but the accurate differentiation between (1) basal pleural infection, (2) subdiaphragmatic or perihepatic infection, (3) intrahepatic or liver abscess and (4) subhepatic, perirenal or perisplenic infection may be extremely difficult.

Certain diagnostic aids must be relied on in this difficult problem of exact localization and even these have considerable limitations in many ways. First, when signs of obscure infection develop after abdominal surgery, especially in conjunction with definite or potential peritoneal contamination, a subdiaphragmatic abscess should always be considered. There may be no symptoms referable to this area or, at most, only *vague discomfort in the low thoracic or subcostal regions*. Deep tenderness may be demonstrated on pressure over the lower ribs, and the diaphragm will be elevated and fixed on percussion. Usually, however, there are variable degrees of associated basal pulmonary atelectasis, pleural reaction and effusion further to obscure the clinical findings. This makes it difficult to estimate accurately, on physical examination or fluoroscopy, the height of the diaphragm or the degree of the intrathoracic reaction above the diaphragm. In larger abscesses, containing free gas, there may be hyperresonance to percussion with reduction of the area of normal liver dullness.

The diagnostic procedure of the greatest value is the roentgenologic examination in which roentgenograms are taken with the patient in three positions: anteroposterior, sitting up; anteroposterior, lying on his side with the affected side up, and a lateral film with the patient sitting up. These three views in the positions described will frequently demonstrate a shifting collection of gas beneath the diaphragm which is obscure in the routine films usually taken with a sick patient lying on his back. Certain common bacteria, notably the colon bacillus group, and mixed infections, may produce gas within the abscess which results in the characteristic roentgenologic findings (Fig. 197, a and b). When a shifting collection of gas cannot be demonstrated and the roentgenograms show a diaphragm obscured by basal pleural reaction, there may still be a subphrenic abscess present. Basal empyema, intrahepatic, or even subhepatic abscesses such as in the gallbladder

bed or Morrison's pouch, however, will often give an identical roentgenologic picture. This has been observed repeatedly in cases of amebic abscess of the liver.

Localization of an abscess under the left diaphragm by the roentgenogram is even more difficult. Owing to the anatomical relation of the left lobe of the liver, the stomach and spleen to the diaphragm, an abscess is more likely to dissect around and between these structures rather than to present a major part of its surface to the diaphragm as

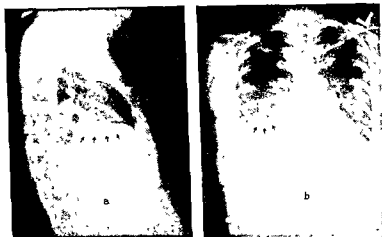


Fig. 197 —a, Lateral roentgenogram with patient upright, showing gas bubble under right diaphragm. b, Same as a, anteroposterior view.

it does over the dome of the right lobe of the liver. Therefore, very little reaction may be demonstrable by the roentgenogram above the diaphragm, or a shifting collection of gas below the diaphragm. The most valuable diagnostic finding is an abnormal displacement or distortion of the air bubble in the fundus of the stomach. This detail should be carefully observed by fluoroscopy and roentgenograms taken at different angles.

If a diagnostic shifting gas bubble cannot be demonstrated by properly taken roentgenograms, a diagnostic aspiration must be considered. In most instances the diaphragm rises high and the costophrenic pleural angles are obliterated, so such an aspiration is usually safe from pleural contamination and is warranted especially if the patient is ill and running a septic course and his condition demands immediate localization of the infection and adequate surgical drainage. Another practical point with reference to diagnostic aspiration is the fact that sometimes pus, presumably obtained from the pleural cavity during a thoracentesis for what appears to be a basal empyema, may actually

be aspirated from beneath a very high obscured diaphragm, and an erroneous localization be assumed. If this happens, the patient will invariably complain of pain in the top of the shoulder as the needle encounters the diaphragm. If pus is aspirated before such a diaphragmatic reference of pain is elicited, the infection is in the pleural cavity; if afterwards, it is below the diaphragm. It is, therefore, essential to be alert to this helpful localizing diagnostic sign.

Finally, if roentgenograms and aspiration are inconclusive, surgical exploration of the subdiaphragmatic region is justified in cases in which decline is rapid as a result of an obscure infection and in which roentgenologic studies and attempted aspiration have failed to yield evidence of a definite diagnosis but in which there are reasonably positive clinical evidences that a subdiaphragmatic infection exists. Exploration can be done readily under local anesthesia with virtually no risk to the patient and this may well be a life-saving measure.

### SURGICAL TREATMENT

The surgical approach for drainage of a subdiaphragmatic abscess (Fig. 198, a [1]) in the posterior subphrenic spaces is through one of two routes: through the bed of the resected twelfth rib, and by blunt dissection, retroperitoneally and entirely extrapleurally, the subdiaphragmatic space involved is broken into and drained. This has the advantage of avoiding the pleura and possible contamination, but the disadvantage that, from this lower level, a much greater amount of tissue must be traversed to reach these invariably high collections of pus under the diaphragm and a much longer and less direct drainage tract must be maintained. In addition, it is well to remember that, owing to anatomical variations, the pleural reflection will be encountered as low as the twelfth rib in 30 to 10 per cent of the cases.

I, therefore, favor the more direct route at a higher level, crossing the lower costophrenic reflections of the pleura. A posterior section of the eleventh rib (Fig. 198, a [2]) is resected and the corresponding length of its intercostal bundle removed to enlarge the exposed surface of parietal pleura. *Considerable care must be taken at this point to prevent pleural contamination and pneumothorax.* If the costophrenic pleural reflection has not been obliterated by the inflammatory process which can readily be determined by the appearance of the pleura and observing the two surfaces sliding freely on each other or being held apart by fluid, one of two methods of obliterating this costophrenic pleural angle must be carried out. A firm gauze pack placed against the exposed parietal pleura and left in place for forty-eight hours will effectively seal off the pleura. This has the distinct disadvantage of making a two-stage procedure of the operation with several days' delay before the final drainage is accomplished and the patient relieved of the marked signs of infection. Therefore, if the time element due to the patient's condition is important, the costophrenic pleural surfaces can

be sutured together with very fine interrupted sutures (Fig. 198, b) placed around the *entire* periphery of the exposed pleura and the pleura and diaphragm beneath opened directly into the abscess by an incision

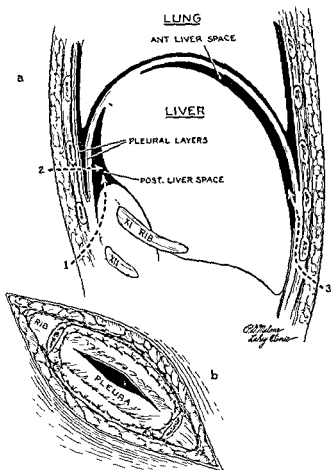


Fig 198 —a, Sagittal section to show approach to subdiaphragmatic abscess by way of (1) the twelfth rib, (2) the eleventh rib, and (3) the subcostal anterior approach. Arrows represent course of drain.

b, Detail to show method of obliterating the costophrenic pleural angle by overlapping sutures between the parietal and diaphragmatic pleura.

in the center of this sutured off area, without fear of contamination of the pleura. The abscess can readily be reached through this approach and excellent and direct drainage obtained. The drainage is maintained by inserting a soft rubber chest tubing or cigaret drain together with

a small catheter for irrigation and instillation of penicillin or other antibiotic. The anterior space and the subhepatic infections (Fig. 193, a [3]) can be drained very satisfactorily by a subcostal incision several inches to the right of the xiphoid process, carrying the dissection upward close to the under surface of the costal margin in order to keep within the walled off area and to avoid entering the general peritoneal cavity.

#### SUMMARY

The incidence of subdiaphragmatic and perihepatic abscess has been greatly reduced by adequate chemotherapy in conjunction with direct or potential peritoneal contamination.

The diagnosis and localization may be difficult but can be accomplished by careful clinical observation, roentgenologic studies, diagnostic aspiration, and if necessary, by exploration.

Prevention is the best solution to the problem and can be accomplished only by early operation or treatment of the primary source of infection. In gastrointestinal, biliary and traumatic surgery, the serious complication of subdiaphragmatic abscess may be prevented by: (1) careful walling off of the primary infection during the operation; (2) complete aspiration with suction of all fluid or pus found in the peritoneal spaces and over the dome of the liver; (3) the instillation of penicillin solution into these areas at the close of the operation; and (4) adequate chemotherapy postoperatively.

The technic of drainage of subphrenic abscess is presented and the various methods and approaches evaluated.

# INFECTIOUS HEPATITIS

GEORGE O. BELL

INFECTIOUS hepatitis, although primarily of medical interest, is of interest also to the surgeon particularly in the differential diagnosis of jaundice. During wars the disease has occurred in epidemic proportions, and the most recent war was no exception. Most of our present knowledge of the disease was gained through the studies made during World War II. Now that the war has ended, the incidence of the disease has fallen off markedly, although sporadic cases will always appear. Their early recognition and proper management are important in preventing the distressing late sequelae which may occur.

The term, infectious hepatitis, applies to a distinct clinical syndrome which we now believe to be caused by a filtrable virus. It is the same entity which has been known as catarrhal jaundice. It is also closely related to homologous serum jaundice. The exact relationship of these two diseases is not yet clearly understood, but at present it is thought that each is due to a filtrable virus belonging to the same general group, although to separate immunologic strains of the same group.<sup>8</sup>

## ETIOLOGY

The causative agent of infectious hepatitis has not yet been identified or isolated. Most of our information about it has been gained through experiments using human volunteers, since there are no laboratory animals which are susceptible. The hepatitis agent is filtrable and resistant both to heat and to the ordinary chlorination of water.<sup>9</sup> It is present in the blood and feces of patients in the pre-icteric and early icteric stages of the disease. It is usually spread from patient to patient by way of the intestinal-oral route, but it may also be transmitted by the parenteral administration of infected blood products. The former mode of transmission has been responsible for most of the epidemics, and water, food and milk have each been implicated.<sup>10</sup> The latter method may account for at least some of the cases of hepatitis appearing in patients receiving antisyphilitic treatment in clinics in which the same syringe is used on successive patients.

## PATHOLOGY

The pathologic changes consist of an inflammatory reaction and degeneration of the hepatic parenchyma.<sup>11</sup> As the disease progresses, areas of active regeneration of liver cells appear, the normal lobular pattern becomes disarranged, bile canaliculi become dilated and bile thrombi may be present. In fatal cases, there is a massive autolytic necrosis of the liver parenchyma, and in the fulminating form, liver



cell regeneration is conspicuously absent. In addition to pathologic changes in the liver, there may be changes in the kidneys, intestine, lymph nodes and spleen. Biopsy studies of the liver in all stages have shown that active hepatitis may exist without clinical jaundice. Inflammatory, degenerative and regenerative changes are present in the liver for days before the development of clinical icterus and for many weeks following its disappearance.

### CLINICAL PICTURE AND COURSE

The clinical picture of infectious hepatitis is fairly uniform.<sup>1,11,22</sup> It usually runs a benign course, lasting about four weeks and ending in complete cure. The onset is usually acute, with fever up to 103° F., chilly sensations, headache, lassitude, generalized muscular aches, anorexia, gas, cramps, abdominal distention and upper abdominal distress. There may be mild diarrhea, nausea and sometimes vomiting. These symptoms usually last for three or four days and, at this stage, the disease is indistinguishable from influenza, infectious mononucleosis or other acute illnesses. The fever then subsides and a relatively symptom-free period of five to ten days occurs, only to be followed by a recurrence of symptoms and the appearance of jaundice. During the pre-icteric stage the liver is usually not enlarged, although it may be tender. About 17 per cent of cases have no prodromal stage, the appearance of jaundice being the first sign of the disease.

The icteric stage begins with the onset of jaundice and may last from two to ten weeks. The jaundice reaches its peak in about five to seven days and is accompanied by fever, anorexia, nausea, vomiting, light stools, rapid weight loss and painful enlargement of the liver. The pain is associated with tenderness and sometimes muscle spasm and this triad has occasionally led to operation for ruptured peptic ulcer, acute cholecystitis and acute appendicitis, especially when the jaundice has not yet appeared. With the disappearance of jaundice there is marked improvement in symptoms, the appetite returns, and a sense of well being ensues. The liver usually decreases in size at this stage, although it may remain enlarged for some time. Jaundice disappears one to several weeks before the pathologic process in the liver has fully subsided, and complete recovery, therefore, may require a total of six to eight weeks. About 10 per cent of patients have not fully recovered at the end of three months.

**Variations in the Clinical Course.**—In a number of cases, the clinical picture is the same as that just described except for the absence of clinical jaundice. It is believed that this variation of the disease occurs as frequently as the icteric form. The diagnosis of this type is based on the presence of an enlarged or tender liver plus chemical changes in the blood indicative of hepatic impairment. The failure to recognize this type has often led to improper or inadequate treat-

ment, which in turn has favored the development of chronic hepatitis or an acute recrudescence more severe than the original attack.

Chronic hepatitis may follow the icteric or nonicteric forms of acute hepatitis. Most patients with acute hepatitis recover completely within three months. Those who do not may have both subjective symptoms and positive physical and laboratory evidences of liver dysfunction. Some may have abnormal physical findings without symptoms and a few may continue to have symptoms long after all objective evidences of hepatic impairment have disappeared. Liver biopsies in such cases have shown normal histologic findings in some, minimal changes in others, and definite pathologic changes in still others. There is no doubt that chronic hepatitis may persist in some individuals for a long time following the acute attack.<sup>2,14,15,16,20</sup>

Fatal cases of hepatitis may run either a subacute or a fulminating course. In the subacute type the patient dies of progressive liver failure.<sup>12</sup> Jaundice is variable and often mild. Ascites and edema usually develop. Death occurs in hepatic coma about nine months after the initial onset. In the fulminant form death occurs in less than ten days and occasionally in as short a time as three or four days.<sup>14</sup> A few patients have died even before the appearance of jaundice. The course of this form is marked by its rapidity and also by the development of mental disturbances. The latter are occasionally so prominent as to lead mistakenly to exploratory craniotomy. Jaundice is usually mild, although just before death it may be quite deep. Ascites occurs in 25 per cent of the patients.

Superimposed infections may modify the course of infectious hepatitis.<sup>10</sup> Since the disease is often contracted from the ingestion of contaminated water, food or milk, it is not surprising to find that other infections which are naturally transmitted in this manner may also be present. The various enteric infections, such as dysentery, typhoid fever and paratyphoid fever, may be engrafted on a case of naturally occurring infectious hepatitis. During World War I, the frequent association of infectious hepatitis and certain strains of *Salmonella* led some investigators to postulate an etiologic relationship. Studies of epidemics of infectious hepatitis revealed in some patients the presence of organisms of the *Salmonella* group in the blood, feces and bile, while the serums of these patients showed strong agglutinations for various strains of *Salmonella*. Other investigators failed to identify consistently any organism with infectious hepatitis and it was suggested that when jaundice and paratyphoid fever appeared together in large numbers of patients, they constituted double infections. Such combinations of infectious hepatitis and *Salmonella* infections were also encountered in World War II. The course of the illness in these patients is more severe and prolonged and may be accompanied by complications peculiar to each separate disease, such as gastrointestinal hemorrhage, perforation and so forth. Havens and Wenner<sup>10</sup> have recently reported

2 cases of infectious hepatitis experimentally transmitted to 2 human volunteers in which the disease was complicated by superimposed infection with *Salmonella choleraesuis*.

### HOMOLOGOUS SERUM JAUNDICE

The relation of homologous serum jaundice to infectious hepatitis has not entirely been clarified. Whether it is a variant of infectious hepatitis or a separate and distinct entity is not known. It, like infectious hepatitis, is caused by a filtrable virus. It is transmitted from one patient to another by the parenteral administration of human serum or plasma. Amounts of serum as small as 0.01 cc. are capable of passing on the disease.<sup>26</sup> Serum hepatitis has occurred after the administration of measles and mumps convalescent serum, yellow fever vaccine containing human serum, pappataci fever vaccine, plasma or whole blood. To date, human albumin has not been found guilty.<sup>2</sup>

The clinical course of patients with homologous serum jaundice is similar to that of patients with infectious hepatitis. The main differences are the longer incubation period (two to four months), a more insidious onset, the absence of high fever and a longer course in the former disease.<sup>22</sup>

The most probable source of the disease at the present time is plasma. The reported incidence in recipients of pooled plasma ranges from 4.5 per cent to 7.3 per cent, with a fatality rate as high as 12.5 per cent.<sup>24</sup> In the operation of blood banks, the practice of pooling the plasma from a number of donors increases the hazard of hepatitis, since the plasma from a single infected donor will contaminate an entire pool. Attempts have failed in prevention of serum hepatitis by the administration of gamma globulin to each recipient of plasma. Ultraviolet irradiation<sup>21,20</sup> of plasma has been effective in eliminating the icterogenic agent, and this procedure gives promise of being helpful in prevention of the disease. Until more work is done to prove the effectiveness of this control measure, the use of human plasma or blood carries a risk of hepatitis which in some cases will be fatal.

Serum jaundice may also be transmitted through the use of unsterilized syringes and needles in the drawing of blood or the injection of any type of substance. Careful adherence to sterile technic in any clinic in which large groups of people may inadvertently be exposed to the possible risk of hepatitis is an additional control measure of value.

### DIAGNOSIS

The diagnosis of infectious hepatitis is usually not too difficult and can be made with a fair degree of accuracy.<sup>4</sup> The greatest difficulties are encountered in sporadic cases and particularly in those without jaundice. There is no specific test for the disease. Clinical symptoms along with objective evidence of liver disturbance serve to make the diagnosis.

A history of jaundice in other members of the patient's family or close contacts, or a history of recent injection of plasma, blood or serum is especially valuable.

In the prodromal or pre-icteric stage the symptoms are those of any acute febrile illness. The presence of an enlarged or tender liver and abnormal results of liver function tests are enough to make a presumptive diagnosis. Many tests of liver function are available, although they are not of equal value in every stage of the disease.<sup>8,19</sup> In the pre-icteric stage, bilirubin is found in the urine even though the serum bilirubin is normal or only slightly elevated. The promptly reacting serum bilirubin and the urine urobilinogen are usually increased. These three tests are reportedly most useful. In addition to these, the cephalin-cholesterol flocculation test, the thymol turbidity, the thymol flocculation, and the bromsulfalein tests may also be abnormal.

The icteric stage is only rarely confused with other diseases, such as obstruction of the biliary tract, hemolytic jaundice, Weil's disease and amebic hepatitis. The presence of an enlarged liver is an important finding. Liver function tests are of importance chiefly in following the course of the jaundice.

The convalescent stage is marked by the decrease and disappearance of jaundice and usually a return of the liver to normal size. The urine urobilinogen test which frequently is normal during the height of the jaundice becomes increased early in the convalescent stage and gradually declines as improvement occurs. The cephalin-cholesterol flocculation and the thymol turbidity run a fairly parallel course. Both become negative about the tenth to twelfth week. The serum bilirubin, especially the delayed type, is increased at first and gradually returns to normal as the liver improves. A persistence of abnormal retention of bromsulfalein is an important sign of prolonged activity of the hepatitis. Continued elevations of thymol turbidity and of the quantitative urine urobilinogen are also excellent indicators of continued activity of the process in the liver.

### PROGNOSIS

Most patients with infectious hepatitis run a mild to moderately severe course but go on to complete recovery. The mortality rate has been reported as 0.2 to 0.4 per cent. Chronic liver dysfunction occurs in as high as 28 per cent of cases. In a small number of patients cirrhosis will develop but neither the exact number nor the type of cirrhosis is definitely known.<sup>12,20</sup>

### TREATMENT

The treatment of acute infectious hepatitis has been fairly well standardized and consists in the main of bed rest, diet and protection of the liver against further injury.<sup>4,21</sup> The value of bed rest has been proved beyond a doubt. Inadequate rest delays recovery in all cases. It may convert a mild nonicteric case into a severe one with jaundice

which in some instances ends fatally. It often leads to a relapse or recrudescence which is more prolonged and severe than the original attack. Bed rest should, therefore, be continued for a week or more beyond the complete disappearance of symptoms, jaundice and liver tenderness. Tests of liver function should be within normal limits before full resumption of activity is permitted. Finally, tenderness or enlargement of the liver after exercise should not occur.

It is universally agreed that the diet should be high in protein and carbohydrate. The amount of fat, however, is still an unsettled point. Without going into the arguments for and against fat, it appears that a moderate amount is permissible. An average diet would, therefore, include about 150 gm. of protein, 400 gm. of carbohydrate, and 40 to 50 gm. of fat. The diet should be modified to suit each individual case to obtain the greatest nutritional benefit.

Vitamins are ordinarily used and may be conveniently given as one of the high potency multivitamin products once or twice a day. We prefer, however, to use a natural vitamin B in moderately large doses.

It is our practice to give choline chloride in doses of 3 to 6 gm. a day, although there is no conclusive evidence that either choline or methionine is particularly useful in cases of acute hepatitis.

When anorexia, nausea and vomiting interfere with the nutritional status of the patient, glucose and amino acid solutions may be given intravenously. When the serum albumin level is below the normal of 3.8 gm. per 100 cc., human albumin, in doses of 50 to 100 gm., should be administered intravenously daily until the serum albumin level has been restored to normal. Saline solutions may be administered when needed, but the amount should be limited because of the tendency toward water and salt retention which frequently occurs in liver disease.

Gamma globulin<sup>6,7,27</sup> is of no value in the treatment of acute infectious hepatitis. Even when administered early in the course of the disease it fails to attenuate or modify it. It is useful in prevention, however, and a dose of 0.06 cc. per pound of body weight will protect against the disease for a period of six to eight weeks.

### CONCLUSIONS

Infectious hepatitis (catarrhal jaundice) is an acute inflammation of the liver caused by a filtrable virus and transmitted from patient to patient by way of the intestinal-oral route or by droplet injection.

It usually runs a self-limited course ending in complete cure. It may, however, go on to a prolonged chronic hepatitis which may be active or inactive. Occasionally it results in cirrhosis, and in about 0.3 per cent of cases it ends fatally.

Homologous serum jaundice, closely related to infectious hepatitis, occurs following injection of whole blood or blood products in about 5 per cent of recipients. Human plasma is a major source of the disease

and until adequate control measures are available, the use of plasma should be limited to those who present definite indications for its use.

The treatment of acute hepatitis consists of bed rest, diet and protection of the liver against further injury. The importance of complete and adequate rest is emphasized. The diet is high in protein and carbohydrate and low in fat, with added vitamins and choline.

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## THE RELATIONSHIP OF HEPATIC INSUFFICIENCY TO CHRONIC ULCERATIVE COLITIS

JOHN R. ROSS

THE problem of hepatic insufficiency in association with chronic ulcerative colitis has received increasing attention recently. In 1938, Comfort, Bergen, and Morlock reported 4 cases of chronic ulcerative colitis and concomitant liver disease. Two of these patients had had biliary tract disease presumably antedating the appearance of colitis. More recently, Tumen, Monaghan and Jobb described 5 cases of cirrhosis and chronic ulcerative colitis. Liver damage was demonstrated clinically, in the laboratory, or peritoneoscopically. In one case the authors believed that excessive alcohol intake together with a deficient diet contributed to the production of cirrhosis. In the remaining 4 cases in which serum protein values were determined they found consistently low values. They emphasized the importance of a low albumin fraction persisting in the presence of replacement and supportive therapeutic measures. Tumen and Bockus had previously demonstrated the tendency toward hypo-albuminemia in a series of patients with known chronic hepatic disorders not specifically related to ulcerative colitis. In a study of clinical and autopsy cases of chronic ulcerative colitis it was our conclusion<sup>1</sup> also that the low serum protein value and the tendency to, or actual reversal of, the albumin-globulin ratio were frequent reasons for suspecting hepatic insufficiency of critical magnitude. Since evaluating that group of 27 necropsied cases there have been 4 additional deaths in patients who suffered from chronic ulcerative colitis upon whom autopsies have been performed. In each of these instances at least one serum protein determination was obtained. In 2 cases, to be described briefly, the serum protein levels were normal and there was no significant liver damage. Weight loss was pronounced, ulcerative disease involved the entire colon in each case, and anemia was marked in one case. The cause of death in Case 14 was designated peritonitis and in Case 15 renal insufficiency. Death occurred in the latter instance six days after a second stage colectomy had been performed for advanced chronic ulcerative colitis with polypoid degenerative changes of the mucosa. In the former case peritonitis was diffuse and resulted from multiple perforations of diseased colon. The third and fourth cases herein described will be given in somewhat greater detail to illustrate one or two points which seem worthy of mention.

### REPORT OF CASES

CASE 30.—A 36-year-old man had progressed favorably under medical management for a period of approximately five years when the number of dejections containing blood and mucus began to increase from an average of two to ten or fifteen



daily. There was an associated weight loss of 20 pounds. Proctoscopy revealed an acutely inflamed, ulcerated and edematous rectal mucous membrane on several occasions. There was roentgenologic evidence of involvement of the entire colon by changes characteristic of ulcerative colitis. Radiographically, these changes were most marked from the splenic flexure to the rectum. Owing to inability to maintain adequate balance compatible with life by medical means, surgical intervention was proposed and accepted. Accordingly, an hemicolectomy and abdominoperineal resection of the left colon and rectum were performed, with the construction of a transverse colostomy. The patient's condition was supported by parenteral fluid, transfusions, and sulfonamide locally in the field of operation. Beginning on the third day after operation, however, the temperature rose and the pulse gradually increased. On the fifth day the temperature was 103.5° and the pulse 135. The nonprotein nitrogen level increased to 110 mg. per 100 cc. and was accompanied by a suppression of urine. Efforts to balance this by adequate amounts of fluid given parenterally were of no avail. Penicillin therapy was without beneficial effect. There was progressive anemia. The hemoglobin level dropped from 13.4 gm. before operation to 5.9 gm. after operation. The red blood count decreased from 4,200,000 before operation to 2,880,000 the day before death. One serum protein value was recorded. Its level five days before death was 6.2 gm. A primary indication of liver insufficiency was suggested by the occurrence of jaundice with serum bilirubin levels of from 6 to 8 mg. per 100 cc. two to three days before death, thus proving to be a terminally occurring event. The patient died on the eleventh postoperative day.

Bacteriologically, both antemortem and postmortem specimens confirmed the presence of a *Pseudomonas aeruginosa* septicemia. At autopsy the cause of death was determined to be uremia. The liver revealed a severe degree of toxic degeneration, as did the kidneys and epithelium of the adrenal glands. Of incidental interest was the finding of two mulberry gallstones, 1.5 cm. in diameter, within the gall-bladder without concomitant evidence for extrahepatic or intrahepatic biliary tract damage.

*The method of classifying the severity of liver disease, when present grossly and microscopically, has been previously described.<sup>1</sup> The fourth and last of the recently autopsied cases is of interest from several points of view. Some of its salient features follow and serve to demonstrate a few of the difficulties one may encounter in treating patients with hepatic insufficiencies with other complications—in this case sepsis.*

**CASE 31.**—A man, 63 years of age, had had diarrhea for six months. He experienced from six to ten liquid dejections daily, most of them at night and all containing blood and mucus. He had lost 9 pounds.

Proctoscopy revealed an edematous mucosa which bled freely. A few linear mucosal ulcerations and some external hemorrhoidal tags were observed. A biopsy specimen obtained from above the sphincter level on the anterior wall of the rectum was reported to show inflammatory tissue and a mucosal polyp. No ova of parasites or ameba were discovered. Roentgenograms of the colon revealed what was thought to represent segmental colitis involving the transverse and descending colon. The patient was hospitalized for further observation and treatment. Blood pressure and pulse were normal on admission. The temperature fluctuated between 98.6° and 102° F. until five days before death when it dropped to 100.5°.

On admission the patient was placed on 3 gm. of sulfathaladine daily. Solutions of glucose with vitamins and amigen were administered intravenously on alternate days. Essenamaine, 50 to 75 gm. orally, was supplied daily. Bismuth in powder form and antispasmodics were given to aid in controlling diarrhea. There was no evidence of obstruction but the patient continued to be ill and lethargic. In addition to the above measures, as the patient's condition seemed to require it he was given 2 units of plasma and 500 cc. of blood on alternate days. Careful tabulations of the fluid intake and output were kept. Sodium chloride was administered orally in daily doses of 3 gm. to help to counteract low blood chloride levels—this in conjunction with chloride given parenterally. Liberal quantities of vitamins were given orally, fully realizing the probability of poor alimentary absorption. Penicillin, 240,000 units daily, was given parenterally in an effort to help stem the adverse effects of what was thought to be peritonitis complicating chronic ulcerative colitis. The patient was experiencing approximately five loose dejections each twenty-four hours. The abdomen was distended. Edema developed over the presacral, scrotal and left leg areas. Administration of chlorides and plasma was temporarily stopped and the patient promptly became worse, following which plasma and blood were resumed parenterally. Edema failed to disappear with the administration of mercupurin. Cardiac arrhythmia developed and coupled rhythm was established. An electrocardiogram was interpreted as probably suggesting myocardial degeneration. Bronchial breathing ensued. Digitalization was begun, diuretics were given, and a small quantity of human albumin was made available to the patient. An ileostomy had been deferred because of the patient's poor condition. Examination of the upper gastrointestinal tract by fluoroscopy and roentgen rays was negative for deformity suggesting organic disease. The patient died on the twenty-eighth hospital day.

Laboratory studies at first revealed an anemia; the hemoglobin was 7.5 gm. and erythrocytes numbered 2,710,000 per cubic millimeter. Later the hemoglobin was recorded as 14.8 gm. and the red cell count rose to 4,930,000, three days before death. The increase was partially due to the dehydration effect. At first the white cell count, with a total of 13,000 cells, revealed an elevation of lymphocytes, 47 per cent, with 7 per cent monocytes. Later the neutrophilic series totaled 87 per cent, of which 37 per cent were polymorphonuclear cells and 50 per cent were neutamyelocytes. The remainder of this series was composed of 9 per cent lymphocytes and 4 per cent monocytes. The nonprotein nitrogen value was within normal limits. The blood chloride values varied between 82 and 90 milli-equivalents (normal 95 to 105). Serum protein determinations were recorded from 3.8 to 4.9 gm. Albumin fractions ranged from 2.1 to 2.8 gm. and globulin values totaled from 1.6 to 2.5 gm.

At necropsy the colon from the splenic flexure to the rectum was bound to the left paracolic gutter by purulent exudate resulting from advanced chronic ulcerative colitis which had perforated. There was widespread universal degeneration of the polypoid type with the appearance of sinus tracts and the formation of pseudo-hypertrophic membranes. The liver was enlarged, weighing 2320 gm. It showed a wide variety of changes which were diffuse in character; they included chronic passive congestion, acute and chronic periportal inflammation, dissolution of hepatic tissue and fatty degeneration with areas of regeneration of liver cells. Other pertinent findings were bilateral hydrothorax, hydropericardium, ascites, dependent edema of sacral and lower extremity areas, hypertrophy of the left ventricle, focal myofibrosis of the heart and generalized arteriosclerosis. Sepsis was termed the cause of death in this case. Postmortem blood culture of the heart

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TABLE 1  
NO LIVER DISEASE\*

Case	Age (years) and Sex	Duration	Jaundice	Serum Protein and Albumin-Globulin Ratio	Fatty Change	Cause of Death
1	20 M	2 yrs.	0	0		Inanition
2	54 M	20 yrs.	0	T.P., 6.3	1+	Undetermined
3	72 F	3 yrs.	0	T.P., 6.7		Undetermined
4	24 F	7 yrs.	0	0		Sepsis
5	26 F	3 wks.	0	0	1+	Pulmonary embolism
6	46 F	?	0	0	1+	Pancreatitis
7	57 M	4 yrs.	0	0		Pulmonary embolism
8	53 M	6 wks.	0	0	1+	Undetermined
9	45 M	3 wks.	0	0		Collapse
10	20 M	1 mo.	0	0	2+	Undetermined
11	51 M	2 yrs.	0	0	2+	Paralytic ileus
12	47 M	3 mos.	+	0	1+	Bronchopneumonia
13	28 M	1 mo.	0	T.P., 4.4	1+	Peritonitis
14	13 M	1 yr.	0	T.P., 5.9	2+	Peritonitis
				A, 3.9 G, 2.5 } = 1.36		
15	34 M	8 yrs.	0	T.P., 6.4	2+	Renal insufficiency

\* There was no cirrhosis or toxic hepatitis in any of these cases

Males 11 } 15      Average age, 39.3 years  
Females 4 }

Average duration, 3.17 years

Average age of 31 cases, 36.55 years.

Average duration of illness at death in 31 cases, 3.2 years.

Division of sexes in 31 cases, males 15; females 16.

In Table 2 are listed a group of 16 necropsied cases in which there was objective evidence of a significant degree of hepatic insufficiency. There were 12 women and 4 men. When classified as to the type of liver damage present it was discovered that fatty metamorphosis of marked degree occurred in 10 women and in 1 man. Cirrhosis or toxic hepatitis occurred in six instances, divided equally between women and men. In one instance, a woman, both severe fatty metamorphosis and early cirrhosis occurred concomitantly. The average duration of illness before death was 3.23 years. The average age at death in this category was 33.8 years. In 50 per cent of the cases peritonitis was the cause of death. Lung abscess and sepsis were primary causes of two other deaths. Icterus occurred in 5 cases, all of which revealed a significant degree of liver damage.

These data suggest that liver damage not infrequently occurs in those patients in whom severe ulcerative colitis has appeared early in

abated. Dejections have been formed and have averaged one daily. There has been no significant weight loss since the initial operation upon the common bile duct.

This case represents a rare instance of hepatobiliary disease in advanced chronic ulcerative colitis secondary to extrahepatic obstruction of inflammatory nature. The latter was not specifically identified as to etiology except by its occurrence with severe and crippling chronic ulcerative colitis. The patient's capacity to combat the deleterious effects of these toxic insults to the liver was apparently limited by active disease of the colon.

It would seem that this patient has slim hope of surviving her advanced liver disease. Jaundice in addition to being uncommon in chronic ulcerative colitis usually is a terminal event but may also be present for variable periods of time before death ensues. In one of our cases icterus occurred two years after onset of colitis and persisted until death occurred four years later. The seriousness with which jaundice must be considered in this disease is suggested by the fact that, in the group of 31 cases, 5 of 6 jaundiced patients also revealed severe liver damage.

We have found, as already stated, that when abnormal proteins were reported significant liver damage could be expected. This usually occurred in instances in which malnutrition, anemia and active ulcerative colitis were advanced. When we controlled this series with a similar analysis of livers in 100 unselected routine necropsies, it was found that hepatic disease was not increased in incidence when associated with chronic ulcerative colitis<sup>3</sup> *per se*. One can infer, however, that ulcerative colitis when advanced and active, may be the primary initiating factor of a chain of events mentioned which ultimately will result in irreversible liver damage.

Analysis of the present group of 31 cases from different angles adds other interesting points. Fifteen cases are listed in Table 1 in which no liver damage was demonstrable at autopsy. This group is composed of 11 males and 4 females. The average duration of illness before death was 3.17 years, and the average age at death was 39.3 years. Death was attributed to sepsis or peritonitis in 3 of 15 cases. In the remainder of this group, death was ascribed to undetermined causes or other diseases not particularly related to septicemia or allied conditions. Icterus appeared in only one case and it occurred suddenly on the thirtieth hospital day, with concomitant severe anemia. Death was precipitous due to bronchopneumonia. In this case icterus appears to have been the result of the combined effects of the hemolytic and toxic influences of the anemia and bronchopneumonia respectively, plus sulfonamides which were terminally administered. It may be postulated that the sudden intervention of death terminated any possibility of significant liver damage which could be demonstrated at autopsy.

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5	26 F	3 wks	0	0	1+	Pulmonary embolism
6	46 F	?	0	0	1+	Pancreatitis
7	57 M	4 yrs.	0	0		Pulmonary embolism
8	53 M	6 wks.	0	0	1+	Undetermined
9	45 M	3 wks.	0	0		Collapse
10	20 M	1 mo.	0	0	2+	Undetermined
11	51 M	2 yrs	0	0	2+	Paralytic ileus
12	47 M	3 mos.	+	0	1+	Bronchopneumonia
13	28 M	1 mo.	0	T.P., 1.4	1+	Peritonitis
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TABLE 2  
LIVER DISEASE

Case	Age (years) and Sex	Duration	Jaundice	Serum Protein and Albumin-Globulin Ratio	Liver Disease			Cause of Death
					Fatty Change	Carcinoma	Toxic Hepatitis	
16	52 F	1 mo	0	0	3+			Long abscess Thrombophlebitis
17	31 F	3 mos	0	T.P., 9.6 A, 4.7 } G, 4.76 } = 0.98			2+	
18	30 F	4 yrs	0	T.P., 6.0 A, 2.8 } G, 3.2 } = 0.88	2+	0	2+	Cardiac failure
19	38 F	1½ yrs.	0	T.P., 4.8	4+	1+	0	Peritonitis
20	27 F	4 mos.	0	0	3+			Ileus
21	30 F	9 wks.	0	0	3+			Peritonitis
22	20 F	4½ mos	0	0	4+			Peritonitis
23	22 M	3 mos.	+	0	4+			Peritonitis
24	47 F	27 yrs.	P.N.	0	4+			Peritonitis
25	22 M	7 yrs.	+	T.P., 5.7 A, 2.5 } G, 3.2 } = 0.78	2+	4+	0	Hepatic failure
26	24 F	2½ mos	0	T.P., 5.95	4+			Chronic ulcerative colitis with hemorrhage
27	26 F	3 yrs	0	T.P., 6.45	3+			Peritonitis
28	19 F	2 yrs	0	T.P., 4.4	3+			Peritonitis
29	54 F	5 days	+	0	3+			Peritonitis
30	36 M	5 yrs.	+	T.P., 6.2	1+	0	1+	Uremia
31	63 M	6 mos	0	T.P., 3.8 A, 2.2 } G, 1.6 } = 1.4 T.P., 4.9 A, 2.6 } G, 2.3 } = 1.0	0	1+	0	Sepsis

Males 4 } 16 Average age, 33.8 years  
Females 12 } Average duration of illness at death, 3.23 years

6 patients had carcinoma or hepatitis

Males 3

Females 3

11 patients had fatty metamorphosis

Males 1

Females 10

1 patient had both advanced fatty metamorphosis and early carcinoma.

life and in whom the duration of the disease tends to be relatively short but not necessarily of the acutely fulminating variety. Conversely, major liver damage is not so likely to occur apparently in those individuals whose disease has been relatively mild, of longer duration, and whose death has occurred at a relatively later age. These remarks are consistent with the concept already alluded to regarding the tendency to irreversible liver damage in the presence of severe mal-

nutrition, anemia, and the chemically demonstrable hypoproteinemic state. When the terminating events culminate rapidly from sepsis or other toxic causes, such as uremia and bronchopneumonia, the actual toxic degeneration may be diffuse and involve not only the liver (to a recognizable but pathologic degree) but other viscera as well. In such instances insufficient time must have elapsed for this abnormality to have been reflected entirely in the blood before death. In connection with these statements, generally speaking, the finding of a normal serum protein value is not as significant with regard to hepatic insufficiency as is the discovery of an abnormal value. In only one instance in 14 cases in which serum proteins were reported was an abnormal value recorded in a case in which no significant liver damage existed. On the other hand, in 6 cases in which severe liver damage was demonstrable, the total serum protein was reported to be normal. In only 3 of these, however, were the albumin and globulin fractions quantitated. In each instance the albumin-globulin ratio was reversed. The albumin fraction actually was below the limit of normal in 2 of these cases. The fourth and remaining case in this group with hepatic disease, in which albumin and globulin levels were reported, revealed an abnormally low total serum protein and low serum albumin. This makes a total of three instances in which the albumin when recorded was found to be low in cases of significant liver damage, with a reversal of the albumin-globulin ratio in a fourth instance in which the albumin itself was normal quantitatively. Albumin and globulin factors were measured once in the series in which no liver disease was found at autopsy and both total protein and its fractionated portions in this case were normal. This is admittedly a small number of cases on which to judge the significance of albumin and globulin determinations. A relationship, however, between significant hepatic insufficiency and abnormal proteins with special reference to the albumin fraction is suggested. These data provide added stimulus for obtaining, more frequently at least, serum protein values and their respective fractions, along with other screening liver function tests whenever hepatic insufficiency may be impending or actually present.

Other factors which are revealing about this disease and its relation to hepatic dysfunction concern its duration and sex incidence. In the total group of 31 cases here presented, there were 15 men and 16 women. General consensus indicates that chronic ulcerative colitis occurs in each sex approximately with equal frequency. In the group with no objective evidence of liver disease there were 9 men and 4 women, whereas in the category showing definite liver abnormality there were 12 women and 4 men, exactly a 3 to 1 relationship in this small group. One is led to believe from the foregoing discussion that when the disease is severe, advanced, and occurs in the female, there is a greater probability of resultant irreversible hepatic damage.



## SUMMARY

Our studies seem to indicate that liver damage in chronic ulcerative colitis is *not more common than would be expected in other disease states in which elements of malnutrition, anemia and hypoproteinemia are severe*. More advanced and fulminating cases of chronic ulcerative colitis are prone to occur in the younger group of patients and in this category significant liver damage is also more likely to occur. The cause of death here commonly was *peritonitis or sepsis in our series*. By the same token the milder cases of chronic ulcerative colitis terminating in death usually occur in patients at a later age than those whose disease is severely active and advanced, although this is not always true, of course. Liver disease of significant degree in this group also is not common.

Marked liver damage in association with chronic ulcerative colitis occurred in our series three times as commonly in women as in men, thus agreeing with the experience of Turnen et al.<sup>6</sup> as regards the predominance of this abnormality in women.

Jaundice is a rare entity in chronic ulcerative colitis as a complication of the disease but its occurrence is preponderantly indicative of severe liver damage. It may be a terminal event associated with severe hemolytic and toxic effects of the disease before other signs of serious liver damage occur. This was true in one of our cases in which death intervened and anatomical evidence of significant liver disease was lacking. Jaundice which is present for a long time before death is not frequently encountered but it usually heralds the approaching demise of the patient.

Serum protein determinations with tests for albumin and globulin fractions done serially are the most significant indicators of irreversible liver disease in our experience. Emphasis is made that these fractions should be tested for in conjunction with a carefully selected group of liver function tests for the purpose of screening out liver damage whenever it is suspected clinically. In a series of definitely known cases of chronic ulcerative colitis we were unable to demonstrate significant liver damage by clinical analysis or by an evaluation of a series of 10 liver function tests routinely performed. Hepatic insufficiency of major character may be difficult to exclude in this manner. This point has been classically demonstrated in animals by the experiments of Bollman and Mann who demonstrated that as much as 80 per cent of an animal's liver may be extirpated without impairment of its function as judged by the liver function tests.

It is not within the scope of this paper to discuss therapy but it is apparent that to prevent complicating liver disease one must bring to bear all supportive measures available for this purpose. If a carefully planned medical regimen fails to halt the apparently inexorable downhill course of the patient, steps should be taken sufficiently early and

at the proper psychologic and physical moment to effect surgical relief before irreversible systemic changes, which may directly or indirectly affect the liver, have intervened.

### CONCLUSIONS

An analysis of experiences at the clinic with significant hepatic disease in chronic ulcerative colitis has been presented.

A series of 31 patients with chronic ulcerative colitis who have come to necropsy were studied. There were 15 men and 16 women in this group. Sixteen were classified as having significant anatomical liver damage. Of these, 12 were women and 4 were men. Fifteen (11 men and 4 women) had no significant liver disease. Six patients had jaundice as a complication of their illness, 5 of whom also showed significant liver damage anatomically.

Comparisons were made in these groups regarding the age at death, duration of illness and cause of death. The role of jaundice and the significance of tests for the serum proteins in particular, as well as other liver function tests, were discussed.

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## THE DIAGNOSIS AND TREATMENT OF PORTAL CIRRHOSIS OF THE LIVER

EVERETT D. KIEFER

PORTAL cirrhosis of the liver, sometimes referred to as Laënnec's cirrhosis, atrophic cirrhosis or alcoholic cirrhosis, may be defined as a chronic and usually progressive hepatitis with extensive fibrosis in the periportal areas, destruction of the liver cells, obstruction of the portal circulation and serious impairment of hepatic functions.

The clinical manifestations of a chronic progressive disease of the liver vary widely and depend upon the stage of the pathologic process when the patient is observed. The liver apparently has a functional reserve comparable with its size, with the result that extensive damage of the viscus may occur before any clinical signs or symptoms develop.

### SYMPTOMATOLOGY

The earliest symptoms of portal cirrhosis are nonspecific and may be difficult to recognize as arising from a liver disorder. Such symptoms as anorexia, malaise, upper abdominal fullness and distress, and flatulence are too common in many digestive disorders to be useful in leading to a diagnosis of early cirrhosis unless the physical examination reveals an enlarged liver or some icterus of the sclera.

Meager as these symptoms and signs of early cirrhosis are, they are nonetheless important because it is at this stage when most can be done to alleviate the disease. Appropriate blood studies and liver function tests done under even such indefinite indications may lead to an early diagnosis or at least to an early presumptive diagnosis of portal cirrhosis.

With the development of portal hypertension which usually occurs in more advanced cases, the symptoms and the clinical signs are more obvious and point more directly to the liver as the chief site of pathologic changes. By the same token, this feature indicates serious irreversible liver damage. Unfortunately, most patients with portal cirrhosis do not seek medical aid until this stage of their disease is present. The manifestations of hepatic insufficiency are numerous but usually are not prominent until the disease is far advanced.

Blood changes, such as hyperchromic anemia, leukopenia, thrombocytopenia, disturbed prothrombin and fibrinogen formation, are fairly late developments. The blood picture under these conditions may simulate that of pernicious anemia.

Impairment of the production and storage of glycogen or of the deamidization of amino acids to form urea and the failure of the detoxifying functions of the liver are late or even terminal developments. Hypoglycemia, acidosis, and a uremic-like intoxication and coma are the results.

## PHYSICAL SIGNS

While the liver is usually enlarged and smooth in the early stages, it gradually shrinks as fibrosis develops and becomes "hobnailed" or irregular and hard to palpation. As the fibrosis of the periportal spaces progresses there is gradual production of portal hypertension which is in part compensated by the enlargement of veins which in certain areas form an anastomosis between the portal and systemic circulations. Consequently, dilated veins observed over the abdomen and lower chest are signs of portal obstruction. Hemorrhoids also develop owing to the anastomosis between the superior hemorrhoidal plexus and the middle and inferior hemorrhoidal veins. The so-called spider angiomas of the abdominal wall are signs of portal hypertension. Other varicosities occur in the gastrointestinal tract, particularly in the veins of the esophagus and stomach, but they are not apparent on physical examination.

Ascites is a common finding in patients with moderately advanced and late cirrhosis. The abdomen may contain only a small amount of free fluid which appears to accumulate slowly, or a massive quantity of fluid which greatly distends the abdomen, elevates the diaphragm and recurs rapidly after tapping. Dependent edema may be present when liver damage is well advanced.

Glossitis and other signs of avitaminosis are fairly common. Progressive weight loss is the rule and when combined with an enlarged fluid-filled abdomen, the face, arms and legs appear strikingly thin.

Jaundice is usually not deep. Some icterus of the sclera is present at some time in a majority of cases. It may disappear and recur intermittently.

## LABORATORY DATA

Certain laboratory data when properly interpreted and added to the clinical signs and symptoms complete the diagnostic picture.

The serum bilirubin level may be increased from the normal level of 0.2 to 0.5 mg. per 100 cc. to from 1.0 to 5.0 mg. per 100 cc. and the prompt or direct van den Bergh reaction shows a relatively greater increase than does the delayed or indirect reaction. Further evidence of impairment of the bile pigment metabolism is the increased urobilinogen in the urine.

Cirrhosis may be present, however, without producing any abnormal values for the various bile pigments in the serum and urine. Even when the jaundice is fairly deep the stools remain colored, which is an indication that the jaundice is nonobstructive in type.

Some of the more sensitive liver function tests give evidence of impaired hepatic function early in the disease.

The most sensitive and most useful tests for the detection of slight degrees of liver impairment are the cephalin-cholesterol flocculation test and the thymol flocculation test (Neefe). The Neefe and Reinhold

modification of Hanger's cephalin flocculation test is used in this clinic and readings of three plus or four plus are considered evidence of at least some liver damage. The thymol flocculation test is also quite sensitive but since the results of these two tests are not exactly parallel, both tests are usually employed for screening patients suspected of having slight liver disease.

The thymol turbidity test (Maclagen) is somewhat less sensitive and therefore not as useful as a screening test.

The bromsulfalein test is also a good screening test and gives a quantitative estimate of the impairment of the excretory function of the liver.

The comparator block method, with a dosage of 5 mg. of dye per kilogram of body weight, is used in this clinic. Retention of 4 per cent or more of the dye in forty minutes is considered definite evidence of hepatic impairment.

Other less sensitive tests are of value in estimating the degree of liver damage in cases of obvious disease. In this clinic the tests most often used are the serum albumin and globulin determinations, the prothrombin time and its response to parenteral vitamin K therapy, the total blood cholesterol and the intravenous hippuric acid test.

A decrease in the total serum proteins to less than 5.5 gm. may be considered to be indicative of serious liver damage. The albumin fraction is the first to be reduced. A value of less than 3.8 gm. of albumin is a positive test. In advanced cases of cirrhosis the total proteins may be reduced to less than 4.0 gm. Under such conditions ascites and edema are usually marked.

Marked reduction of the prothrombin (70 per cent of normal) and particularly if it is not improved by parenteral administration of vitamin K, is a sign of grave liver impairment.

The total cholesterol is usually less than 180 mg. in patients with liver impairment and this test may be used as a confirmatory test, particularly in the differentiation of obstructive and nonobstructive jaundice.

The intravenous hippuric acid test usually shows diminished excretion to ranges of 0.2 to 0.4 gm. as compared to the normal of 1.0 gm. The test is subject to error and depends upon accurate collection of the urine.

A more detailed account of liver function tests may be found in the report of Norcross and Bradley also appearing in this volume.

Mateer and his associates have recently published a comparative study of the most widely used liver function tests.

#### ROENTGENOGRAPHIC DATA

The roentgenogram has been used in this clinic in connection with cirrhosis of the liver mainly in the diagnosis of esophageal varices. A large proportion of esophageal varices which bleed can be demon-

strated on the roentgenogram as *smooth, elongated, convoluted*, filling defects in the lower part of the esophagus (Fig. 199), but failure to *demonstrate* dilated esophageal veins in this way does not necessarily rule out portal hypertension.

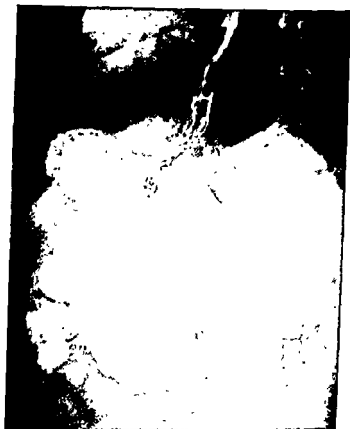


Fig. 199.—Positive evidence of esophageal varices is shown in this roentgenogram. The dilated veins projecting into the lumen of the lower esophagus produce smooth, rounded filling defects. •

A plain film of the abdomen may be of some value in estimating the size of the liver but it is not an accurate measurement.

#### BIOPSY OF LIVER TISSUE

The most accurate information concerning the presence as well as the degree of cirrhosis is obtained from the microscopic study of a

biopsied specimen of the liver parenchyma. The chief problem of this test is to obtain the specimen of tissue without endangering the patient.

The excision of a small piece of liver is not a serious procedure during a laparotomy, but abdominal exploration is to be avoided in liver disease and is seldom justified except when the clinical evidence makes it impossible to rule out an obstructive lesion in the biliary tract.

Needle biopsy of the liver has been used by several investigators and some valuable information is made available by this method. This procedure has not been used routinely in this clinic but reviews of the subject have been published by Hoffbauer and by Volwiler and Jones. Needle biopsy is not without risk and is probably not adaptable to the routine study of clinical cases. Certainly, it should not be done unless there are adequate facilities for coping with the complications, chiefly hemorrhage, which may arise.

### TREATMENT

The treatment of patients with primary liver disease may be divided into three sections.

The first includes the measures used in dealing with active inflammation or other current processes leading to damage to the liver. Alcohol is interdicted as one of the initial steps. Although the etiologic responsibility of alcohol in portal cirrhosis of the liver may be open to some question, the extremely common association between chronic alcohol consumption and this disease leaves little question but that alcohol is at least an important factor which aggravates chronic hepatitis of this type. Adequate nourishment is usually a problem because anorexia amounting sometimes to a marked aversion to food is common in this disease. Frequent small feedings of malted skimmed milk and fruit juices supplemented by intravenous administration of glucose and amino acid solutions have been used to overcome the acute failure of the patient's nutrition. Bed rest is essential in this stage.

The second group of therapeutic measures includes those that are designed to support the chronic insufficiency of the liver and to prevent recurrences of active and progressive liver damage. The general nutrition of the patient is of first importance. The high carbohydrate, high protein and low fat diet is generally accepted and has been used in this clinic with an effort to make the diet as liberal and attractive as possible. The restriction of fat to 50 gm. or less per day has not always been attempted since a diet containing approximately 75 to 100 gm. of fat per day is more acceptable and more faithfully maintained by patients. Liberal quantities of skimmed milk, malted milk, protein hydrolysates and fruit juices are useful in planning the diet.

Since there is considerable evidence suggesting that portal cirrhosis is a complex deficiency disease, large doses of vitamins, particularly the B complex group, and ascorbic acid are used. The common dosages



are: thiamine hydrochloride 10 mg., niacinamide 300 mg., and riboflavin 10 mg., *three times a day*. A glass of orange juice or 100 mg. of ascorbic acid *three times a day* supplies the vitamin C.

Lipotropic substances such as choline and methionine are now in general use but the benefit actually derived is still a matter of experiment. One gram of choline or methionine or both may be given two or three times daily.

The third group of therapeutic measures may be described as treatment of the conditions which are secondary to severe liver disease. Increased intraportal pressure is the most striking of these conditions. It is the result of inflammation and fibrosis in the portal spaces which cause pressure on the portal sinusoids. There is evidence that portal stasis may increase rapidly with a flare-up of hepatitis, and decrease with a recrudescence of the acute inflammation. As a result, there may be intermittent periods of compensation and decompensation of the portal circulation.

One of the signs of decompensation is the accumulation of ascitic fluid in the abdomen. Although ascites developing in a patient with cirrhosis has serious prognostic significance in many instances, energetic treatment of the liver has resulted in a disappearance of the abdominal fluid. Large accumulations of ascitic fluid may cause severe embarrassment of digestion, respiration and circulation, and temporary relief can be obtained by paracentesis. Since the withdrawn fluid represents considerable loss of serum protein which the patient with cirrhosis can ill afford to lose, certain operative procedures have been designed to restore the ascitic fluid to the general circulation. Omentopexy is one of these but is not very satisfactory in most cases. A glass button modified by Crosby and Cooney and used by them to maintain a sinus between the abdominal cavity and the subcutaneous tissues is an ingenious and promising maneuver. Comparatively few patients have been treated by this method and consequently the practical usefulness of this procedure is yet to be determined.

In the medical treatment of ascites, liberal quantities of water may be allowed if the salt or sodium is restricted to a minimum. Ammonium chloride and mercurial diuretics may produce diuresis and reduction of the ascites.

Treatment of the lowered serum protein has a beneficial effect on ascites and edema. Transfusions of whole blood, plasma and serum albumin are used to increase the osmotic pressure of the blood.

Gastrointestinal hemorrhage, arising from increased intraportal pressure, is a frequent and serious complication and is often a terminal event in portal cirrhosis. The bleeding usually results from rupture of dilated esophageal veins.

Treatment of the acute hemorrhage consists of complete inactivity in bed, heavy sedation, stopping all food and drink by mouth and multiple transfusions of whole blood.

Rowntree and his associates have reported 2 cases in which the hemorrhage from the esophagus was controlled by intra-esophageal venous tamponage. They used a latex rubber bag placed in the lower esophagus and distended with air.

The treatment of esophageal varices by injection of the veins with a sclerosing solution has resulted in several encouraging reports. This method has several hazards and is not always successful. Moersch has reported good control of hemorrhages in 12 of 22 patients.

The problem of portal hypertension has also been attacked by venous anastomosis between the portal and general circulations. These procedures apparently are applicable particularly in cases of increased intraportal pressure not caused by cirrhosis of the liver. In cases of cirrhosis the coincident hepatic insufficiency makes such surgical procedures extremely hazardous.

### SUMMARY

The diagnosis of portal cirrhosis of the liver should be suspected in patients with a history of chronic alcohol ingestion or a previous attack of hepatitis. The symptoms of early cirrhosis are nonspecific, but anorexia, nausea and upper abdominal distress are common.

The physical findings that should cause the suspicion of cirrhosis are enlargement of the liver, mild icterus, anemia and spider angiomas.

The obvious physical findings are weight loss, ascites, edema, jaundice, dilated abdominal veins and splenomegaly.

Recent developments in liver function tests have supplied implements for study of the status of hepatic function, thereby adding to the diagnostic picture.

A better understanding of the physiology of the liver and advances in the knowledge of the nutritional aspects of this disease have improved the prognosis. Cirrhosis is no longer a hopeless disease, ending in early death, but there is much that can be accomplished in retarding or arresting chronic hepatitis. Furthermore, definite measures can be used to prevent and to treat hepatic decompensation.

Portal hypertension remains an outstanding problem but progress is being made in its solution.

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## ASCITES: ITS TREATMENT

KENNETH W. WARREN

ASCITES, an abnormal accumulation of fluid in the peritoneal cavity, is a physical finding common to diverse diseases. The physical and chemical characteristics of the ascitic fluid vary in accordance with the etiologic agents responsible for the ascitic accumulation.

Normally, the peritoneal cavity contains from 100 to 200 cc. of clear amber fluid. It is estimated that the presence of 1500 cc. of fluid in the peritoneal cavity may defy precise clinical detection by gravitating to the inaccessible recesses of the abdominal cavity.

### ETIOLOGY

Ascitic collections result from a disturbance in the equilibrium between capillary permeability and the colloid osmotic pressure of the plasma. Thus, factors which increase the capillary permeability or lower the osmotic pressure of the plasma contribute to the formation of ascites. In practical physiologic dynamics each factor is usually altered adversely during certain phases of the formation of ascites.

The causes of ascitic accumulations may be divided arbitrarily into the following several categories. It is common to have more than one factor operative in each instance.

1. Venous obstruction. Increased resistance to venous flow is the most common cause of ascites. This resistance may reside in either the portal or general circulation, or both. Congestive heart failure, in which venous flow is diminished in both the general and portal circulation, is the most important single etiologic agent in the development of ascites.

Portal obstruction, due primarily to cirrhosis, presents specific diagnostic and therapeutic problems which now engage the attention of numerous clinical and laboratory investigators.

Obstruction of the inferior vena cava by tumors, constrictive pericarditis or thrombosis is an uncommon but dramatic cause of ascitic accumulation.

2. Renal disease, in the form of chronic glomerular nephritis or nephrosis, presents difficult therapeutic problems associated with ascites.

3. Protein deficiency, representing inadequate intake, improper absorption, deficient assimilation, or excessive destruction or excretion, may be a precipitating or sustaining factor in the disturbance of the colloidal osmotic system responsible for intracellular and inter-compartmental fluid distribution.

4. Inflammation of the peritoneum or abdominal viscera results in an exudative form of ascites by increasing capillary permeability.

5. Lymphatic obstruction produces chylous ascites.
6. Ruptured viscus.

### DIAGNOSIS

The historical indications of ascites comprehend a gain in weight, an increase in abdominal girth, fullness, discomfort, weakness and peripheral edema. By and large, these symptoms are insidious and progressive. The past history may suggest an illness in which ascites is a common accompaniment or sequel.

The physical examination reveals the characteristic fullness in the flank, fluid wave, ballottement and shifting dullness. In large accumulations the skin may be tight and glistening, with distention of veins of the abdominal wall.

Röntgenograms of the abdomen may confirm the diagnosis but this method is rarely necessary and not always reliable.

Diagnostic paracentesis may be of value when the amount of fluid in the peritoneum is small.

### TREATMENT

The treatment of ascites is essentially medical, particularly since the ascitic accumulations, in most instances, result from a disease which is primarily medical in its therapeutic considerations. The proper management of the underlying illness, of which ascites is only a symptom, is the fundamental principle in therapy.

The limitation of fluid intake to approximately 1500 cc. in each twenty-four hour period is usually adequate, but the primary disease to which the ascites is related may dictate variations in this schedule. The character of the administered fluid should be such that it will either directly or indirectly increase the osmotic pressure of the blood and the quantity should not be sufficient to increase the blood volume materially.

Sodium chloride should be restricted to 2 gm. each day.

The encouragement of diuresis is an effective means of eliminating abnormally retained fluid from the body. As the fluid is excreted there is a tendency toward restoration of the compartmental fluid equilibrium in the various tissue reservoirs, with gradual disappearance of the ascites. Diuresis may be affected by the administration of acidifying salts such as ammonium chloride, by mercurial diuretics including mercupurin and salyrgan, or by increasing the osmotic pressure of the blood by infusions of plasma or albumin. Less physiologic but physically effective in this last regard is the administration of acacia or pectin solutions. The side effects of these plasma substitutes may render their use undesirable, particularly in the presence of liver damage.

Dietary considerations should govern the administration, via oral and parenteral alimentation of large quantities of protein or its derivatives.

**Mechanical and Operative Treatment.**—Despite vigorous medical measures the ascitic accumulation may require mechanical removal. This may be done by simple paracentesis at intervals, dictated by the patient's discomfort or by embarrassment of the circulation or respiration. Initially, if there be any question as to the nature of the underlying pathology, one may prefer to perform the paracentesis through the peritoneoscope, which has the advantages of permitting the removal of the fluid, the visualization of the gross pathologic change in some instances and the obtaining of a biopsy specimen if indicated.

That paracentesis is not a satisfactory method of treating ascites is reflected by the numerous, and often ingenious, operative attacks upon the condition.

Omentopexy, proposed by Drummond and Morison and Talma and tested by many surgeons,<sup>2,4,7,9</sup> gave unpredictable but essentially discouraging results and was attended by a high operative mortality.

Ferguson attempted to relieve ascites by performing a right nephrectomy and anastomosing the renal pelvis to the peritoneum. Others have attempted to anastomose the saphenous vein to the peritoneum in order to shunt the ascitic fluid back into the circulation. The operation was usually unsuccessful owing to omental blockage of the stoma.

More recently, following the publications of Blakemore and Lord and Whipple, attempts have been made to relieve the portal hypertension of cirrhosis by direct portacaval anastomosis or by removal of the spleen and left kidney and anastomosis of the splenic and left renal veins. Linton has advocated splenorenal vein anastomoses with preservation of the kidney. These are formidable procedures, which, in our experience, have not proved very satisfactory.

*Use of a Peritoneal Button in the Management of Ascites.*—A less complicated method—the insertion of a glass button into the abdominal wall—has been modified by Crosby and Cooney and applied in a manner which they feel renders it effective.

The button (Fig. 200), which is made of glass, has a double flange with a central hollow core and an additional top plate which serves to prevent plugging of the core by the omentum or viscera.

The dimensions of the button are as follows. The flanges are 2.0 cm. in diameter, the bore is 0.6 cm. and the length varies from 1.0 to 1.5 cm. The top plate is approximately 0.6 cm. below the inner flange.

The button is inserted through the rectus sheath with the lower flange and the top plate projecting into the peritoneal cavity and the outer flange external to the anterior rectus sheath. The purpose of the button is to permit the ascitic fluid to escape through the core into the subcutaneous tissue where it may be absorbed into the circulation.

**Technic.**—The abdomen is opened through a transverse rectus incision opposite the umbilicus. The ascitic fluid is removed by aspiration. The anterior rectus sheath at the lower angle of the incision is



Fig. 200.—Peritoneal buttons made of glass with outer and inner flanges and top plate. The flange attached to the top plate projects into the peritoneal cavity. The inner flange is anchored external to the anterior rectus sheath.

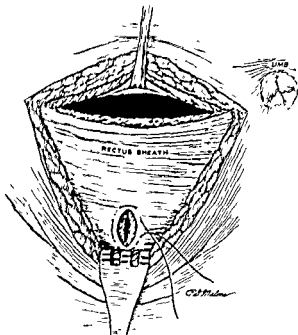


Fig. 201.—The abdomen is opened through a transverse incision opposite the umbilicus. The skin and subcutaneous tissue are reflected from the anterior rectus sheath below the primary incision for a distance of 8 cm. A stab wound is made through the rectus muscle approximately 5 cm. below the initial incision. A purse-string suture is inserted around the stab wound in the anterior rectus sheath by means of which the button will be anchored in position.

exposed for a distance of 8 cm. by elevation of the subcutaneous fat. An opening of sufficient size to permit the introduction of the button is made through the rectus muscle about 5 cm. below the original inci-

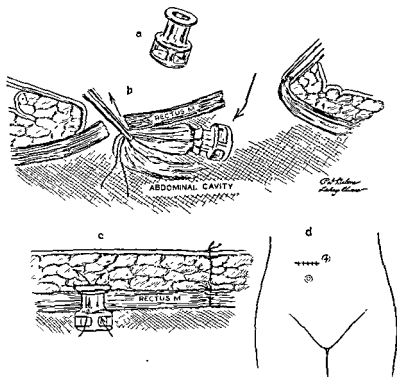


Fig. 202.—a, The peritoneal button.

b, Cross section showing the transverse abdominal incision and the stab wound below. One end of the button has been inserted into a Penrose drain and anchored with a heavy silk ligature. A clamp is inserted through the stab wound to grasp the Penrose drain and ligature in order to guide the peritoneal button into position.

c, The Penrose drain and silk ligature have been removed and the button has been anchored in position by the purse-string suture previously placed in the anterior rectus sheath. The primary incision has been closed in layers.

d, Anatomical topography of the incision and the button.

sion where the anterior rectus sheath has been exposed. The outer flange of the button is inserted into one end of a Penrose drain and anchored with a heavy silk ligature in order that the glass button may be inserted with ease (Figs. 201 and 202). The Penrose tubing is removed and the button is anchored in place with a silk purse-string suture in the peritoneum and anterior rectus sheath. The primary wound is closed in layers.



Our experience with this procedure has been limited but the method appears to be sufficiently effective to warrant further trial. It is perhaps most applicable in the presence of ascites caused by mechanical obstruction of the portal vein or inferior vena cava.

### REPORT OF CASE

A woman, 53 years of age, was admitted to the hospital on April 19, 1947, relating a history of abdominal swelling, edema of the ankles and shortness of breath of eleven months' duration. She had had abdominal paracentesis prior to her examination at the clinic. Several months before admission to the hospital she had sudden blurring of vision of the left eye. She was told at that time that her blood pressure was 210 mm. systolic and 140 mm. diastolic.

The patient was acutely ill. Pitting edema extended from the feet to the costal margin. The neck veins were greatly distended. The blood pressure was 215 mm. systolic and 140 mm. diastolic. Extreme ascites was present. Fundoscopic examination showed blurring of the disks and old and recent hemorrhages. The arm to tongue circulating time with calcium gluconate was 90 seconds. The vital capacity was 1100 cc. The venous pressure was 255 mm. of water.

Laboratory data included the following findings: nonprotein nitrogen was 35 mg. per 100 cc., hemoglobin 12.2 gm. per 100 cc., plasma protein 6.3 gm. per 100 cc. with albumin-globulin ratio of 1:1. Leukocytes numbered 7,000. Urinalysis was negative except for a trace of albumin.

Röntgenograms of the chest demonstrated marked cardiac enlargement without any congestive changes in the lung fields. A biopsy specimen of the liver showed minimal periportal fibrosis.

On April 26, 1947, the abdomen was opened through a right rectus incision, under local anesthesia, and approximately 7,000 cc. of clear amber fluid was aspirated. The skin and subcutaneous fat were elevated from the anterior rectus sheath for a distance of 8 cm. below the inferior angle of the incision. A stab wound of sufficient size to accommodate the peritoneal button was made through the rectus muscle midway between the umbilicus and the pubis. The button was anchored in position with purse-string sutures in the peritoneum and anterior rectus sheath. The primary incision was closed in layers.

Postoperatively, the patient was given puromycin, 0.2 mg. daily, ammonium chloride and periodic mercupurin intravenously. The edema disappeared rapidly except for an area in the anterior abdominal wall overlying the peritoneal button. She lost 100 pounds in weight and required no further paracentesis during the remaining three weeks of her hospital confinement.

### SUMMARY

Ascites is primarily a medical problem.

Surgical procedures applicable to the treatment of ascites are discussed.

The use of a peritoneal button in the management of ascites is recorded.

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## ESOPHAGEAL AND GASTRIC VARICES, WITH REPORT OF A CASE

HUGH F. HARE, ESTHER SILVEUS, AND F. A. RUOFF

THE presence of esophageal and gastric varices occurring in post-mortem studies has long been recognized, but they were not demonstrated roentgenographically until 1928 when Wolf reported 2 cases and described methods of demonstration on the roentgenogram. In 1931 Schatzki reported 5 cases of esophageal and gastric varices in diseases associated with cirrhosis of the liver. Since that time numerous investigators have reported cases, with their methods of study. There has been little information regarding the frequency of the diagnosis of varices. We have been interested in the frequency with which we were able to demonstrate them in those patients with liver disease coming either to operation or postmortem examination.

### TECHNIC OF DEMONSTRATION

Esophageal and gastric varices are demonstrated only by a combined study, including fluoroscopy and films of the distal esophagus and fundus of the stomach. In order that one may demonstrate them fluoroscopically, especially if the varices are small, the patient should be examined in the upright and supine positions and with both thick and thin barium. Spot films taken in various projections are also essential because in many instances small areas of tortuosity are not visible fluoroscopically (Fig. 203, *a*, *b* and *c*).

Esophageal varices must be distinguished from air bubbles, gastric mucosa in small hiatus hernia, tortuous folds seen in older patients, mucus, curling and beading of the esophagus, and esophagitis. When varices involve the fundus of the stomach they must also be differentiated from carcinoma and localized gastritis.

Operation was performed on 23 patients to establish a clinical diagnosis, with cirrhosis of the liver alone being the postoperative diagnosis in 10 cases. In the remainder, there was cirrhosis associated with common duct stones and stricture, carcinoma of the liver, gastric carcinoma and polyposis, and splenomegaly of Banti's type. In 2 of these cases esophageal varices were demonstrated by the roentgenogram. In a third, varices which were not found by fluoroscopy and films were found at operation. In a fourth patient there were large varices, causing a deformity of the fundus of the stomach which simulated tumor. In numerous instances the demonstration of esophageal varices has been made with a clinical diagnosis of cirrhosis of the liver and Banti's disease, but without histologic verification.

These findings would indicate that in the early stages of cirrhosis,

esophageal varices are not present or, if present, are so small that they cannot be demonstrated. Therefore, roentgenography, in our hands, has not proved an effective means of making an early diagnosis of this disease.

Of 16 patients with cirrhosis of the liver coming to autopsy, esophageal varices were present in 9. Twelve of these had been fluoroscoped, with varices demonstrated in two instances, one of which, however, showed no varices at autopsy. This, then, would indicate that varices are present in approximately 50 per cent of the cases at the time of death and that they can be demonstrated by roentgenography in less than 15 per cent. In some of these cases studied, however, the fluoro-



Fig. 203.—a, Small varices of the type which might easily be overlooked if films were not taken. b and c, Varices of varying degrees which are easily seen by fluoroscopy as well as on film study.

scopic examination and roentgen study had been carried out a year or more before death while in other cases, the studies were made at the time the disease was in its terminal stages and a thorough examination could not be carried out. In a few examinations, films were not taken following the fluoroscopic study, which may indicate that a careful examination had not been made in those instances.

In patients with *hematemesis*, the demonstration of varices is particularly important as an aid in differentiating gastric or duodenal hemorrhage from esophageal bleeding, and may save the patient from unnecessary operation.

The following case report presents gastric varices simulating tumor of the fundus of the stomach. Reported cases of varices, 2 by Pape and 1 by Eisler, have shown varices of the fundus causing deformity similar to that being presented. The dearth in reports of this involvement is indicative of the rarity of the disease.

## REPORT OF CASES

A woman, aged 35 years, entered the clinic in August 1945 with the chief complaint of gastric hemorrhage. About eight months previous to admission she had had a sudden attack of violent nausea followed by emesis of a large amount of bright blood. At that time she was hospitalized for one month and was given transfusions. Ascites developed which required paracentesis on four occasions. Following discharge she was in good condition until two months before admission when pyelitis developed for which she was given sulfonamides and four transfusions.



Fig 201—*a*, Spot film taken in upright position, showing deformity of cardia and fundus.  
*b*, Film taken in prone recumbent position showing the deformity of the cardia and fundus with the appearance of an infiltrating mass.

No further nausea or vomiting and no pain had occurred. There was a gnawing sensation in the stomach. The appetite was good. Two years previously abdominal swelling had been present which had subsided.

Physical examination revealed a slightly distended abdomen with no tenderness. The liver and spleen were not palpated. The uterus was enlarged, nodular and retroverted.

Laboratory studies demonstrated a total protein of 7.1 gm. per 100 cc., serum albumin of 4.2 gm. per 100 cc., globulin of 2.9 gm. per 100 cc., erythrocyte count of 1,000,000 to 4,500,000 and a leukocyte count of 5,000 to 9,500. A bromsulfalein test showed no retention of dye after one half hour and also after one hour.

Roentgenologic examination showed a filling defect in the fundus which had the appearance of a tumor mass (Fig 201, *a* and *b*).

At exploration, early cirrhosis of the liver was found, with markedly distended veins scattered along the serosal surface of the stomach. The right and left gastric and left gastro-epiploic vessels were markedly distended and congested. The spleen was four to five times normal size. The vessels of the mesentery were prominent.

The spleen was removed; it weighed 310 gm. The varices along the greater and lesser curvatures caused the filling defect shown in the roentgenogram.

*Pathologic report of the removed specimen was slight fibrocongestive splenomegaly, slight localized fibrosis and subacute inflammation of the liver.*

### SUMMARY

While the roentgenogram has not frequently demonstrated varices in early cases of cirrhosis (those requiring biopsy for clinical confirmation), it is a valuable study when carefully performed, with films taken in all projections.

A case of varices involving the fundus of the stomach which simulated tumor has been reviewed.

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## CHRONIC RELAPSING PANCREATITIS

FRANCIS E. McDONOUGH AND ELMER W. HEFFERNON

CHRONIC relapsing pancreatitis was clearly differentiated from other pancreatic disease and described as a clinical entity by Comfort, Gambill and Baggenstoss from the Mayo Clinic in 1946. Eighteen months later Bartunek and Collins reported their experiences from the Cleveland Clinic. This condition is characterized by recurring attacks of pain in the upper part of the abdomen sometimes associated with disturbances in function of acinar and islet cells of the pancreas and certain sequelae. These include principally calcification and more rarely diabetes, steatorrhea and creatorrhea. The disturbance of secretory function is usually mild and transient with the first relapses of this chronic disease, but it tends to become more prominent with each attack and may become permanent.

The cause is not known, but the pathologic changes found at operation or necropsy are known to vary from edema, inflammation, hemorrhagic necrosis and abscess in the acute phase to atrophy, fibrosis, cyst formation, calcification and stone in the late stages. The damage tends to persist and progress between the clinical attacks. The essential pathologic process seems to be either repeated attacks of acute interstitial pancreatitis, repeated sublethal episodes of acute hemorrhagic pancreatitis or a combination of the two. When pseudocysts or calcification occur, it is apparently secondary to the inflammatory process, while interstitial fibrosis, necrosis and atrophy are constant chronic changes. In many patients with chronic relapsing pancreatitis there is associated disease of the gallbladder and biliary tract or duodenal ulcer, but, although in some cases the relationship may be on an etiologic basis, the involvement of the pancreas alone occurs frequently enough to conclude that it represents a clinical entity.

### DIAGNOSIS

The frequency with which the diagnosis can be made is directly proportional to the suspicion aroused. Diseases in the upper part of the abdomen producing pain are numerous and difficult to differentiate. Biliary colic, cholecystitis, perforating or penetrating duodenal ulcer, aortic aneurysm, hydronephrosis, intermittent intestinal obstruction, tabetic crises and heart disease are usually first considered and must be ruled out by evaluation of the history, physical examination and the results of laboratory tests. Carcinoma of the pancreas or ampulla of Vater may cause pancreatitis which at first resembles primary chronic pancreatitis, but carcinoma is progressive. Retroperitoneal tumors and nontropical sprue must be excluded, the latter when steatorrhea is present.



The spleen was removed; it weighed 310 gm. The varices along the greater and lesser curvatures caused the filling defect shown in the roentgenogram.

Pathologic report of the removed specimen was slight fibrocongestive splenomegaly, slight localized fibrosis and subacute inflammation of the liver.

### SUMMARY

While the roentgenogram has not frequently demonstrated varices in early cases of cirrhosis (those requiring biopsy for clinical confirmation), it is a valuable study when carefully performed, with films taken in all projections.

A case of varices involving the fundus of the stomach which simulated tumor has been reviewed.

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curve. Transient diabetes is not unusual during painful relapses of the disease, but only rarely does it persist after the painful episode subsides. Urinary diastase may be elevated during a painful episode and rarely between episodes.

Stool examinations are rarely done and then only when steatorrhea is present. The stool containing excess fat is usually voluminous, very light colored due to the masking of the bilirubin by fat, has a sheen and may contain recognizable fat seen as liquid, butter masses, flakes or crystals. Pratt stressed the importance of stool examination in chronic pancreatic disease, but in our experience steatorrhea is a rare accompaniment of chronic relapsing pancreatitis and occurs with equal frequency in patients with pancreatic insufficiency owing to malignancy. Carbohydrate and protein digestion is so well carried on in the complete absence of pancreatic juice that the degree of insufficiency encountered in even advanced cases of chronic relapsing pancreatitis is of little aid in diagnosis. We have never examined the feces for pancreatic enzyme activity.

Estimation of pancreatic enzyme activity both with and without stimulation by secretin can be carried out by using the two barrel tube placed in the stomach and duodenum, as described most recently by Lake, but we agree with Dozzi and Bockus' statement, "It seems highly unlikely that any estimation of enzymes in the duodenal fluid in chronic disease of the pancreas will frequently yield information of great diagnostic value which is not suggested by fecal analysis, disturbances of carbohydrate metabolism, roentgen-ray study, physical examination, or serum enzyme tests with the utilization of pancreatic stimulants."

The values for activity of serum amylase and lipase are the most easily demonstrated pancreatic enzymes in the blood and elevation above normal occurs with sufficient frequency during the painful exacerbations to warrant determination in any case of obscure upper abdominal pain. The values may rarely be elevated between the painful episodes. Tests of hepatic sufficiency, such as the value for serum bilirubin, prothrombin, total proteins, albumin and globulin, when abnormal are indicative of liver damage only and do not contribute to the diagnosis of chronic relapsing pancreatitis.

Roentgenograms of the pancreatic area should always be done and calcification in the pancreas can be demonstrated in about 50 per cent of patients with chronic relapsing pancreatitis some time during the course of the disease. Often it is the finding of calcification in the region of the pancreas following cholecystograms, scout films or urograms that first arouses the clinician's suspicion to the true cause for the pain that initiated the investigations. When pancreatic cysts are present they are usually demonstrated by external pressure on the barium-filled stomach, duodenum, jejunum or adjacent transverse

Pain is the most characteristic symptom. This is usually severe, steady and prolonged. At onset it often gradually increases to a plateau and then gradually declines. Opiates are usually required and these merely relieve the pain so that repeated administration is necessary. A cycle of pain may require *hours or days to develop and subside* and then the patient may be free from pain for hours to years before another attack develops. The location in the order of frequency is epigastric, right upper quadrant and left upper quadrant; it may occur as generalized abdominal, right lower quadrant or periumbilical. Several times a notation was made by the attending physician that the pain was typical of cholecystic disease in its distribution. The extension of pain is characteristically to the back in the lower thoracic and upper lumbar regions but it may extend anywhere in the abdomen and chest.

The painful seizures may be accompanied by *nausea, vomiting, diarrhea, constipation, chills, fever, shock or jaundice*, but these symptoms are *seldom severe*. Steatorrhea and creatorrhea are late symptoms because the pancreas, like the liver, has a tremendous functional reserve and advanced destruction is necessary before failure of external secretions results.

The age of onset runs from late childhood to advanced years, but is usually in middle life. There is no sex predilection and overindulgence in alcohol and food is believed by some patients to initiate an attack. *Alcoholism is not unusual, but it is difficult to decide whether liquor was used excessively to relieve pain or whether its abuse antedated the pain*. Certainly, several alcoholic patients who were relieved of their pancreatic pain by surgical procedures subsequently abstained from alcohol.

The physical findings are important primarily in helping rule out other causes for upper abdominal pain. The pancreas lies so deep in the abdomen it is seldom palpable either in health or disease. When a mass arising in the pancreas is palpable it is usually a cyst secondary to damage from previous attacks. The findings depend on the stage of the attack in which the patient is seen. During the height of a severe episode there may be *epigastric tenderness or spasm, more often on the left than on the right, moderate fever, slight jaundice or mild shock*. Between attacks there may be some *epigastric tenderness and evidence of weight loss*, but little else. Then the diagnosis must be considered on the history of episodes alone.

Laboratory diagnosis is limited to demonstrating evidence of infection and pancreatic insufficiency during a relapse or pancreatic insufficiency and stone formation when the patient is investigated between the painful episodes. Leukocytosis is not an important finding, but may occur. Routine urinalysis offers no help except when glycosuria is present. This finding is then demonstrated to be due to pancreatic insufficiency by *blood sugar determinations and the glucose tolerance*

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colon. Invasion or obstruction in addition to distortion of these intestinal segments differentiates pancreatic malignancy from benign cyst associated with chronic relapsing pancreatitis.

When no pancreatic insufficiency or calcification exists, the laboratory is unable to aid the clinician in establishing the diagnosis. When the patient's pain is severe, which is usual, and the relapses are frequent, surgical exploration to establish the diagnosis and correct any concurrent disease of the biliary tract is not only justified, but advisable. It is thus the surgeon often establishes the diagnosis. He usually describes the pancreas as hard and firm, or hard and nodular, like carcinoma, and sometimes as having diffuse inflammatory edema. He usually recognizes calcification and describes it as interstitial or stones in the ducts. Abscesses or cysts can be recognized and dealt with. Some patients, however, are subjected to multiple exploratory laparotomies with removal of nonsymptomatic gallbladders and appendices before the correct diagnosis is made. It is extremely helpful if one of the preoperative tentative diagnoses is listed as chronic relapsing pancreatitis because this focuses the surgeon's attention on this possibility.

#### SUMMARY OF DATA

Seventeen patients with chronic relapsing pancreatitis were hospitalized in five years (1942 to 1946) on the Lahey Clinic service at one hospital alone.

The salient features are listed in Table 1.

TABLE 1

1. Cases		Diarrhea (steatorrhea)	2
Males	9	Constipation	4
Females	8	Jaundice	2
2. Age		6. Physical findings	
Below 40.	4	Epigastric tenderness	11
40 to 50	8	Epigastric mass (cyst)	6
50 to 60	2	Weight loss	14
60 to 70	2	7. Laboratory findings	
70 to 80.	1	Fatty stools	2
3. Duration of Symptoms to Diagnosis		Glycosuria	5
One year or less	5	Hyperglycemia	5
One to 2 years	6	Elevated serum amylase (Done	
Two to 10 years	5	in 8 cases)	4
Ten to 15 years	1	Anemia	2
4. Associated Disease		Leukocytosis	3
Biliary tract	7	8. Roentgenologic findings	
Diabetes.	5	Calcification in pancreas	6
Alcoholism	5	Pressure evidence on adjacent	
5. Symptoms		gastrointestinal tract	4
Abdominal pain	14	Widened duodenal loop	3
Back pain.....	12	Soft tissue mass	2
Indigestion	8	9. Correct diagnosis made preopera-	
Nausea and vomiting.	8	tively	9

## ILLUSTRATIVE CASE

A typical case history of chronic relapsing pancreatitis is presented.

A 39-year-old leather worker came to the clinic on October 7, 1946, stating that for the previous year and one-half he had been suffering from intermittent attacks of epigastric pain. Six months previously, because the pain had become much more severe, he had been hospitalized elsewhere for four weeks on an ulcer program. This treatment afforded little relief during an attack of pain and the episodes continued with decreasing intervals of freedom from distress. The episodes gradually became more prolonged, eventually lasting days, and the pain became more severe. His local physician had found it necessary to use demerol orally to control pain and he was taking up to 35 mg. demerol tablets per week. At times hypodermic injections of morphine had been necessary. With the attacks of pain there was some indigestion characterized by belching and occasionally nausea. He vomited seldom, but had developed the habit of taking laxatives twice a day because he felt better if his bowels moved regularly.

The patient denied previous infection, accidents or operations except for gonorrhea at the age of 21, tonsillectomy at the age of 35 and a fracture of the left hip at the age of 36. Before the onset of his present illness, he had used alcohol to excess, but had discontinued it on his physician's advice two months prior to October, 1946.

His general physical examination gave essentially negative findings except for tenderness in the epigastrium to deep palpation.

Laboratory studies revealed a hemoglobin of 14.3 gm. per 100 cc., erythrocyte count of 4,980,000 and leukocyte count of 7,700 per cubic millimeter. The blood sedimentation rate was 19 mm. in one hour and the Hinton test was negative. The serum amylase measured 107 units which is within the normal range. Urinalysis was negative except for sugar, 2.5 mg. per 100 cc., and a 1 plus albumin on a basis of 1 to 4. Gastric analysis following an Ewald-type meal showed a free acid of 10 and a total acid of 28 clinical units. An oral cholecystogram revealed no visualization of the gallbladder on each of two separate determinations. Roentgenograms of the abdomen showed numerous calculi scattered throughout the pancreatic area. A gastrointestinal series following a barium meal and a barium enema showed a normal esophagus, stomach, small intestine and colon.

The patient was treated on an ambulatory program with a bland, low residue diet and antispasmodics. The attacks of pain continued to recur, however, and he was hospitalized on December 14, 1946. While he was in the hospital opiates were required to control his pain and he continued to show a slight glycosuria, while his fasting blood sugar ranged from 95 to 132 mg. per 100 cc. There was no anemia, leukocytosis or significant change in his blood protein. Because of the nonfunctioning gallbladder, surgical exploration was carried out. There was marked thickening, fibrosis and enlargement of the pancreas which was estimated to be four or five times the normal size. The serosal surface was injected and the pancreatic thickening extended down around the superior mesenteric vessels, and was grossly attached to them. The gallbladder and common bile duct contained no stones and appeared normal. The entire small and large bowel were normal, as were the liver, spleen and kidneys. It was decided that the process was so extensive in the pancreas that a total pancreatectomy would be necessary and the incision was closed as an exploratory laparotomy with the intention later to do splachnicectomy.

Two weeks later a right splanchnicectomy with thoracolumbar sympathectomy from the fifth thoracic to the second lumbar ganglia was done. The patient made an uneventful recovery from this procedure and was discharged twelve days later free of abdominal pain.

Twelve days after dismissal from the hospital, pain developed in the pit of his stomach, without radiation, which lasted for two days and required hypodermic injections for relief. The patient was advised to stop all narcotics and to use only aspirin for pain. After this episode he returned to work and experienced no further pain until May 1947 when, following the drinking of a half pint of whisky a day for a week-end, he developed pain under the left costal margin and into the left back. This type of pain continued to recur in attacks necessitating demerol for relief.

The patient was readmitted to the hospital June 2, 1947, at which time a left thoracolumbar sympathectomy and splanchnicectomy, from the fifth thoracic to the second lumbar ganglia, inclusive, was done. He again made an uneventful recovery and was dismissed from the hospital on his fourteenth postoperative day.

Following the left splanchnicectomy, marked postural hypotension developed which was controlled by a hypotensive corset for two months, at the end of which time the hypotensive symptoms subsided and the corset was discarded.

He was last seen November 28, 1947, and stated that he had had only two mild attacks, each lasting two to three days, in October and November. He had regained all his former weight, appeared healthy and was working.

This case represents chronic relapsing pancreatitis with transient diabetes during the episodes of pain and pancreaticolithiasis. It appears that bilateral thoracolumbar sympathectomy has relieved his pain.

### TREATMENT

Medical treatment of chronic relapsing pancreatitis is limited to symptomatic palliation. When diabetes develops, this manifestation of islet cell insufficiency is managed by diet and insulin. Steatorrhea due to inadequate elaboration of pancreatic enzymes is seldom severe and should be treated by replacement therapy. The most satisfactory preparation is a triple test preparation of pancreatin (holadin) in amounts from 0.2 to 1.3 gm. daily divided with meals. If amylase activity is decreased, taka diastase or a similar compound may be given with meals. Because there is evidence that the healthy pancreas elaborates fat metabolites related to the prevention of fatty degeneration of the liver, choline chloride probably should be used in therapeutic doses.

The diet best tolerated is that used for the treatment of irritable colon and eliminates fried foods, raw fruits and vegetables as well as spices. The values for carbohydrate, protein and fat in the diet should be judged according to the degree of pancreatic deficiency and will vary not only between patients, but in the individual as the disease progresses. Partially digested proteins and amino acids are beneficial when the patient is malnourished. Adequate vitamin and mineral intake should be maintained and a routine of life advised. Alcohol

should be prohibited because many patients develop exacerbations following its use.

During painful attacks analgesics are necessary and often only opiates will give adequate relief. Demerol orally has been helpful and should be used in preference to morphine when possible. One of the clinician's primary responsibilities in this chronic disease is to prevent drug addiction.

Surgery at present offers most to these patients. Not only is the diagnosis and degree of pancreatic involvement established by exploratory laparotomy, but at the same time certain complications can be dealt with. Correction of biliary disease, drainage of pancreatic cysts or abscesses, removal of calculi from the large pancreatic ducts, anastomosis of the gallbladder to the intestine and drainage of the common bile duct are often indicated. Partial or total pancreatectomy has been employed to relieve intractable pain.

Because severe pain is the most disabling part of this disease it presents the greatest challenge. If the attacks occur infrequently and are of short duration, they can be weathered by the use of opiates. When they are frequent and prolonged, the patient is both miserable and useless. Rienhoff and Baker in May 1947 reported a patient with chronic relapsing pancreatitis in whom the severe disabling pain was relieved by transthoracic sympathectomy and vagectomy. These authors believed that both sympathectomy and parasympathectomy were necessary to interrupt all afferent nerve fibers leading from the pancreas. In addition, they postulated this procedure would decrease the stimulus to pancreatic secretion via the autonomies and therefore prevent pain.

At the Lahey Clinic bilateral splanchnicectomy from the fifth thoracic through the second lumbar ganglia has been carried out on 2 patients in addition to the 1 already mentioned in the case report. All 3 patients have been relieved of their severe disabling pancreatic pain by this procedure and are recovering from the resulting post-operative neuralgia and hypotension. Only time will decide whether this result is permanent and whether vagectomy in addition to splanchnicectomy is advisable.

#### SUMMARY

Chronic relapsing pancreatitis is a clinical entity whose chief disabling symptom is severe upper abdominal pain. The diagnosis can be made clinically and these patients retrieved from the limbo to which they are often consigned with an erroneous diagnosis of psychoneurosis or functional pain. The diagnostic features of the disease are discussed as well as the therapeutic approach, both medical and surgical.

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## ACUTE PANCREATITIS

KENNETH W. WARREN

DESPITE the real progress that has been made in the basic understanding of acute pancreatitis, it remains a disease of unknown etiology. It is difficult to diagnose, and is frequently disregarded entirely in the differential consideration of acute upper abdominal pain. Its proper treatment is a subject of debate and in its severe forms, the mortality is exceedingly high despite careful therapeutic management. The complications which may accompany or follow in the wake of the disease are numerous and are frequently of sufficient severity as to affect the outcome adversely.

### ETIOLOGY AND PATHOGENESIS

No single etiologic factor can be incriminated in the genesis of acute pancreatitis. Reflux of bile into the pancreatic duct system secondary to obstruction of the common duct, either by an impacted stone (Opie) or by spasm of the sphincter of Oddi (Archibald), seems plausible in many instances (Dragstedt). Rich and Duff believed that the obstruction is primarily intrapancreatic and results from metaplasia of the duct epithelium. Smyth's investigations, on the other hand, support the vascular origin of hemorrhagic pancreatitis. The possibilities of infection reaching the pancreas by direct extension from the duodenum by way of the pancreatic ducts or by lymphatic or hematogenous spread, cannot be entirely discounted.

### PATHOLOGY

Acute pancreatitis may be characterized by diffuse edema or by varying degrees of hemorrhagic necrosis. In the presence of simple edema the gland is swollen and indurated. When marked necrosis occurs, the peritoneal cavity contains a small amount of bloody fluid. Areas of fat necrosis may involve any part of the peritoneal cavity. The gland in the severe form of the disease is enlarged, friable, and hemorrhagic. In some instances the necrosis is so widespread that no pancreatic tissue is discernible grossly. The retroperitoneal migration of the products of destruction in acute pancreatitis is frequently bizarre and may lead to error in diagnosis.

### SIGNS AND SYMPTOMS

The essential features of the symptomatology of acute pancreatitis have been classically stated by Fitz and subsequently elaborated by many modern authors. Increasing experience with this disease has led us to a realization of the prime significance of the sequence of the symptoms and signs and, more particularly, the successive complications

of acute pancreatitis, as relates to its accurate diagnosis and rational management. The progression of the morbid process of acute pancreatitis can be followed accurately by a careful analysis of the sequential symptomatology and, with increasing experience, the clinical manifestations of the disease can be anticipated and, to some degree, counteracted by prompt therapeutic measures.

The classical portrait of acute pancreatitis was based upon a study of the fulminating type of the disease and, as a result, clinicians were reluctant for many years to make a diagnosis of acute pancreatitis unless the patient presented evidence of cyanosis or shock. Elman has been largely responsible for our current familiarization with the fact that the common form of the disease is mild, and that acute pancreatic necrosis is, indeed, a rare manifestation of the malady. Fallis has demonstrated that even in the severer forms of the disease clinical shock is extremely uncommon.

It is important to realize that in many instances there are no characteristic signs and symptoms of acute pancreatitis, particularly in mild attacks of acute pancreatic edema. It is equally important to recognize that in the devastating degrees of pancreatic necrosis the clinical complex is reasonably predictable. Since it is the latter form of the disease that is largely responsible for the mortality, it is well to emphasize the essential features of pancreatic disruption.

The outstanding symptom of acute pancreatitis is abdominal pain. This pain, in the necrosing form of the disease, is characteristically severe. It is situated in the upper part of the abdomen, with its major intensity centering in the epigastrium. The pain has a constant, unyielding quality, variously described as boring or tearing in character. It frequently extends to the back and left flank. It is aggravated by the ingestion of food or water. The pain is particularly unresponsive to average doses of morphine, and this feature is of inestimable value in the differential diagnosis of acute pancreatitis and biliary colic.

The second symptom of pancreatitis, in sequence and in severity, is vomiting. This vomiting is repeated and prolonged and accounts, in some measure, for the dehydration which frequently ensues. In some instances the vomiting persists after the excruciating pain has subsided and assumes serious proportions if not controlled by gastric suction and proper fluid replacement.

Within forty-eight hours of the onset of pancreatic necrosis the patient usually has obstipation and progressive abdominal distention. These symptoms are insidious and persistent, and occur concomitant with a mounting systemic toxicity if pancreatic necrosis ensues.

The early physical signs of acute pancreatitis are less dramatic than the symptoms, and this feature is exceedingly helpful in the differential diagnosis, provided the patient is seen early in the attack. Despite the severity of the pain and the persistence of the vomiting, frequently there is only moderate tenderness over the upper portion of the ab-

domen and perhaps none in the lower quadrants in the early hours of the illness. As the disease progresses, the tenderness becomes more diffuse and more pronounced and in many instances the abdomen may be rigid and exquisitely tender throughout.

Abdominal distention is not an early sign of the disease. An insidious, progressive ileus is characteristic of acute pancreatitis if the pathologic process is severe. Peristalsis, early in the disease, is active but as the products of pancreatic disruption spread intra-abdominally and retroperitoneally, ileus ensues and is characterized by abdominal distention if adequate measures to combat this serious manifestation are not promptly instituted. This phase of the illness usually presents on the third day and persists for a variable length of time, depending upon the severity of the pathologic process.

In the devastating types of acute pancreatitis, a palpable mass in the epigastrium will frequently appear about the seventh day of the illness. This mass is commonly tender and frequently irregular in outline.

*Cullen's and Gray-Turner's Signs:* Cullen, in 1918, described the discoloration of the para-umbilical skin in ruptured ectopic pregnancy. Since that time the sign has been observed in a variety of conditions. Gray-Turner emphasized the diagnostic value of the sign in relation to acute pancreatitis in 1920, and described a similar discoloration of the skin overlying the flank. Fallis<sup>7</sup> supported the theory that each of these signs is due to extraperitoneal extravasation of blood and not to intraperitoneal hemorrhage, although the latter condition may give rise to discoloration of the umbilicus in some instances.

The discoloration in the flank is accompanied by palpable edema and induration which may be appreciated, although the intensity of discoloration is slight. This edema and induration will appear a few hours before the discoloration and will persist after the color of the skin has returned to normal.

The presence of either of these signs in a patient with a clinical story compatible with acute pancreatitis is diagnostic of the disease. The limitations of the sign are nonetheless considerable. The manifestation occurs only in approximately 10 per cent of cases (Fallis<sup>8</sup>). It is easy to overlook unless it is anticipated, and may even then be missed unless the patient is examined in a bright light. It is for this reason that one should be aware of the palpable evidences of retroperitoneal extravasation of blood, and that one should search for this physical sign in suspected cases of pancreatic necrosis. The most severe limitation of this sign as a diagnostic aid in the study of this disease is its delayed appearance. It usually appears, when it does occur, on the third or fourth day of the illness. Obviously, this late sign will be of no practical value in distinguishing acute pancreatic necrosis from a perforated peptic ulcer at the time the patient is first seen, when it is most imperative to make the differential diagnosis.

Shock, as reflected by significant hypotension, rapid pulse, cyanosis

and collapse, is relatively uncommon in cases of acute pancreatitis, and may be absent even in the presence of widespread pancreatic destruction. Preclinical shock, as manifested by hemoconcentration and diminished blood volume, is, on the other hand, quite common in the severe forms of the disease. Demonstration of progressive hemoconcentration, measured in terms of hemoglobin and hematocrit values, is of considerable diagnostic significance, especially during the early hours of the disease. It is not unusual to observe an initial elevation of these values and to see them increase materially despite the administration of reasonable quantities of parenteral fluids.

During major episodes of pancreatic disruption, considerable quantities of fluid escape into the peritoneal cavity and into the retroperitoneal space, thereby accounting for the diminished circulating blood volume and the hemoconcentration. Blalock and Harkins have emphasized the "lag" between the diminution in blood volume and the appearance of clinical shock and have reiterated the importance of treating patients with this condition before the fall in blood pressure and the increase in pulse rate occur.

Jaundice of mild to moderate degree occurs in some cases, either from compression of the common bile duct by edema of the adjacent portion of the pancreas, or from secondary hepatitis. Since acute pancreatitis is associated with cholelithiasis in from 60 to 80 per cent of cases, the presence of common duct stone cannot be excluded as a factor in the production of the associated jaundice.

#### LABORATORY DATA

Moderate leukocytosis and increase in the granulocytes is common in acute pancreatitis, but no differential characteristics are revealed by a study of the white blood cells.

Progressive hemoconcentration, as reflected by the hemoglobin and hematocrit values, occurs in pancreatic necrosis. Serial determinations of these values should be practiced in the early phase of the disease to determine the fluid requirement necessary to restore and maintain normal blood volume.

Demonstration of the increased amylase activity of the blood and urine in acute pancreatitis is diagnostic of the disease. These values vary considerably, depending upon the severity of the pathologic process. The increase in amylase in the blood appears within a few hours after the onset of the disease, progresses to a peak within forty-eight to seventy-two hours and then returns rapidly to normal. The urinary amylase, on the other hand, remains elevated for a longer time and is, therefore, more helpful in the diagnosis when the patient is seen later in the disease.

Serum and urinary lipase are not consistently altered and cannot be relied upon as diagnostic aids.

Hyperglycemia is an uncommon finding when all degrees of pancreatitis are considered, but in severe pancreatic necrosis it is present in most instances. Fasting blood sugar determinations should be made regularly in every patient suspected of having acute pancreatitis. Diabetes mellitus, with characteristic disturbances in glucose tolerance, should be anticipated whenever pancreatic destruction is great.

Hypocalcemia<sup>4</sup> will also occur in the devastating types of the disease. Therefore, blood calcium determinations should be made at regular intervals and particularly during the interval between the fourth and tenth day of the illness.

### COMPLICATIONS

The complications of acute pancreatic necrosis are responsible for its variegated clinical picture and, to some extent, for its forbidding mortality. They include pancreatic cysts, abscesses, diabetes mellitus, internal and external fistulas and hypocalcemia.

Pancreatic cysts of inflammatory origin are capable of bizarre clinical manifestations. A detailed consideration of this aspect of pancreatic disease is presented in a separate communication in this volume (Warren, p. 753).

Pancreatic abscesses fortunately are uncommon, but areas of cystic degeneration may become infected secondarily and require drainage. This is usually a delayed complication and is manifested clinically by a septic temperature curve with intermittent chills and some tendency toward localization of pain and tenderness. Surgical drainage is indicated.

Diabetes mellitus has been regarded as a rare complication of acute pancreatitis and remarkably little attention has been devoted to the study of glucose metabolism during attacks of the disease. Consequently, Shumacker, in a comprehensive review of the subject in 1910, could collect but 62 cases of acute pancreatitis complicated by diabetes mellitus and in only 25 of these instances did the diabetes appear during the acute pancreatitis. It is our conviction, based on a careful study of glucose metabolism in a small consecutive group of cases of acute pancreatic necrosis, that diabetes is a common accompaniment of the severe form of the disease and that failure to detect and to treat this serious complication contributes, in a measure, to the excessive mortality of the disease. These detailed data are in preparation for subsequent publication.

It is wise to anticipate and to search for evidences of disturbed glucose metabolism and of diabetes mellitus in every instance in which pancreatic necrosis is extreme. The true incidence of diabetes as a complication of acute pancreatitis can be determined only by the routine search for altered glucose metabolism in a large series of patients presenting evidences of pancreatic edema or pancreatic necrosis.

## TREATMENT

It was not until recent years that the clinical diagnosis of acute pancreatitis could be established with reasonable certainty and, even now, there are many instances in which the diagnosis is so obscure as to dictate emergency exploratory laparotomy to obviate the catastrophe of overlooking a perforated peptic ulcer or other acute surgical condition.

More recently, the trend in therapy of acute pancreatitis has been toward conservative treatment. Operative intervention is either delayed or withheld entirely. This conservative management is predicated upon the following observations. First, Whipple demonstrated, in 1913, that the products of pancreatic destruction were not toxic when injected intravenously or intraperitoneally into laboratory animals. Second, no surgical procedure that will definitely relieve the pathologic process is available. It was always a striking observation that in any series of patients treated surgically the mortality was directly proportional to the extensiveness of the operative procedure. Third, the rapid deterioration in the clinical course following operation was usually obvious in those instances in which death ensued. Furthermore, the clinical improvement in those patients who survived operation was rarely so dramatic as to indicate that the operation was the decisive factor in the recovery. Finally, investigators were impressed by the relative number of patients who developed pancreatic cysts following an acute abdominal episode treated conservatively as a result of a mistaken diagnosis. The nonoperative treatment was deliberately instituted in many clinics and the mortality improved.

Today, there is an area of reasonable agreement regarding the virtue of the conservative management of acute pancreatic edema. Unfortunately, there is a diversity of opinion regarding the proper therapy of pancreatic necrosis. Elman, who has had a considerable experience with the disease, favors the operative treatment of acute hemorrhagic pancreatitis. Mikkelsen and Fallis,<sup>8</sup> on the other hand, prefer the conservative therapy in both varieties of the disease.

Our feeling at the clinic is that the treatment of choice is nonoperative in all cases of acute pancreatitis, when the diagnosis is reasonably certain and when no actual suppuration is demonstrable. If there is material doubt as to the diagnosis, surgical intervention is preferable since the mortality of acute pancreatic necrosis is high with any form of therapy, whereas the surgical conditions which are commonly confused with pancreatitis are, by and large, responsive to appropriate surgical attack.

The conservative treatment of acute pancreatitis must be predicated upon an appreciation of the sequence of symptoms as a reflection of the successive stages of the morbid pathologic process involving the pancreas, and the secondary and remote physiologic alterations which accompany the disease.

The immediate therapeutic considerations include: (1) the relief of pain, (2) the restoration of normal blood concentration, (3) the prevention of distention, (4) the prophylaxis against suppuration, (5) the detection and treatment of diabetes and liver deficiency in the severe cases, (6) the detection and treatment of cyst and abscess formations, and (7) the recognition and elimination of hypocalcemia.

The relief of pain requires generous administration of opiates, but these drugs must not be employed with abandon unless the diagnosis is obvious. Recently, attempts have been made to relieve the pain of acute pancreatitis by procaine injection of the splanchnic nerves. This procedure merits further clinical trial, and offers much promise.

The restoration of normal blood concentration and volume should be done without delay. The chief constituent loss is the plasma fraction and, theoretically, at least, plasma should be employed in replenishing blood volume. If plasma is to be used, the Harkin rule may be followed in determining the dose. This rule dictates that 100 cc. of plasma be given for each point the hematocrit is elevated above 45.

It should be remarked, in this regard, that in severely toxic states associated with hemoconcentration, the abnormally high hemoglobin and hematocrit values are temporary, and that this state will be supplanted by one of progressive anemia. Therefore, it is logical to restore the blood volume by the administration of whole blood. As a practical policy, we prefer to employ both plasma and whole blood in the management of this phase of the disease.

Distention may be prevented by the use of the Miller-Abbott tube. The tube should be passed early in the disease when peristalsis is still active. It is extremely important to anticipate the ileus which is so likely to occur in pancreatic necrosis and to prevent it if possible.

The status of glucose metabolism must be watched vigilantly. Many patients with hemorrhagic pancreatitis will have either temporary or permanent diabetes and will require careful control with insulin. The diabetic manifestations are most likely to appear on either the second or third day of the illness, and they may be overlooked unless specifically watched for.

Pancreatic suppuration is always to be feared when any considerable degree of necrosis of the gland occurs. It is possible, although no proof is yet available, that penicillin and streptomycin may alter favorably the tendency in this regard. Until more information is forthcoming with respect to the effectiveness of these antibiotics in acute pancreatitis, it would seem reasonable to employ them generously, particularly during severe attacks.

The development of pancreatic cysts or abscesses as sequelae of pancreatic necrosis must be detected early and treated surgically. The specific treatment of pancreatic cysts is discussed in a separate communication in this volume (Warren, p. 756).

If operation is performed during the acute phase, either as a deliberate exercise or as a consequence of a mistaken diagnosis, the operative



procedure should be limited to simple drainage of the lesser omental bursa, unless the extrahepatic biliary system shows evidence of distention, in which instance the gallbladder or the common bile duct should be drained.

Serial determinations of blood calcium must be made in order to estimate the calcium requirements. This must be given intravenously during the phase of the illness when gastric or intestinal siphonage is required.

### REPORT OF CASES

**CASE 1.**—A man, 73 years of age, first came to the clinic on July 2, 1917 because of periodic abdominal distress of forty-five years' duration. This pain was epigastric in location and intermittent. It was prone to occur during the early hours of the morning or in the evening. Usually, it persisted for about one hour and subsided spontaneously, but upon rare occasions morphine was required for relief.

The patient was thin but well developed and not obviously ill. Routine blood counts revealed no abnormalities. The urine was free of albumin and sugar.

Oral cholecystograms showed no filling of the gallbladder. The esophagus, stomach and duodenum were normal when studied roentgenographically following a barium meal. There was a round opaque shadow at the level of the left transverse process of the second lumbar vertebra which was thought to be a renal calculus.

On August 2, 1917, he was admitted to the hospital following the appearance of severe epigastric pain twenty-four hours before admission. The pain was associated with persistent vomiting and was of such intensity as to require a hypodermic injection of morphine for relief. The patient slept for several hours following the administration of morphine, but he awakened the following morning with excruciating pain which was not relieved by 2 doses of morphine.

The patient was agitated and obviously ill. The temperature was 98, pulse 80 and blood pressure 131 mm. systolic and 70 mm. diastolic. The skin was flushed and dry. The heart and lungs were normal. The abdomen was flat with mild tenderness throughout. There was exquisite tenderness in the epigastrium. No rigidity or masses were demonstrable. Peristaltic activity was normal. Normal liver dullness was present. A roentgenogram of the abdomen was negative except for the opaque shadow to the left of the transverse process of the second lumbar vertebra.

The hemoglobin was 16.8 gm. per 100 cc. of blood. The white blood count was 14,600. The urine contained 1 plus albumin and 3 plus sugar.

A diagnosis of acute pancreatitis was made and nonoperative treatment was instituted.

Despite the absence of abdominal distention and the presence of normal peristalsis, a Miller-Abbott tube was passed into the intestine for the maintenance of constant suction. One unit of plasma (500 cc.) and 1500 cc. of glucose-saline solution were administered shortly after admission. Ten hours later the hemoglobin had risen to 18.1 gm. per 100 cc. Parenteral fluids, including blood, plasma and glucose solutions, were given to prevent the progressive hemoconcentration. The following day the hemoglobin had fallen to a normal value.

On the second day following the patient's admission to the hospital the fasting blood sugar was 210 mg. per 100 cc., the serum amylase was 600 units and the serum bilirubin was 3.4 mg. per 100 cc.

The early clinical course was characterized by the appearance of jaundice, abdominal distention and ileus. Progressive toxicity was reflected by profound mental confusion and a sustained elevation of the temperature, pulse and respirations.

On the sixth hospital day a bluish discoloration, associated with induration and edema, appeared in the flanks, gradually extending anteriorly along the inguinal crease. A tender mass was palpable in the epigastrium the following day. Daily administration of 20 units of protamine zinc insulin and 10 units of regular insulin was required to control the hyperglycemia and glycosuria.

The patient was extremely ill for about four weeks, during which time he was maintained entirely by parenteral alimentation. Gradually the toxicity abated, the ileus disappeared and the diabetes stabilized. He was discharged on September 24, 1917. Six weeks later he was free of pain and gaining weight. He still required 20 units of protamine zinc insulin for control of his glucose metabolism.

*Comment.*—This case epitomizes, in a real sense, the varied manifestations of acute pancreatitis. The severity of the pain, the persistence of the vomiting and the absence of profound shock are common to the disease. The rapid hemoconcentration, the elevated blood amylase and the appearance of hyperglycemia reflect the importance of these data in the early diagnosis of acute pancreatitis. The insidiousness and stubbornness of the ileus point up the necessity for anticipating this common accompaniment of the malady. The delayed appearance of the Gray-Turner sign and the epigastric mass help clinch the diagnosis.

In terms of treatment, the importance of anticipating the hemoconcentration, the ileus and the diabetes, and the prompt institution of measures to combat these threatening features of the disease is obvious.

**CASE 2**—A woman, 66 years of age, was examined at the clinic on October 10, 1916, because of upper abdominal pain of one year's duration. The pain was periodic and severe and extended to the back. It was attended by nausea and vomiting and frequently required morphine for relief. There had been no jaundice. She had had a cholecystectomy in 1910 for calculous cholecystitis. Recent roentgenograms of the gastrointestinal tract were negative except for the demonstration of a hiatus hernia.

The patient was obese and not acutely ill. Physical examination revealed enlargement and tenderness of the liver. Urinalysis was negative.

Gastrointestinal roentgenograms revealed a large hiatus hernia and diverticulosis. The patient was admitted to the hospital on October 14, 1916, and was operated on October 23, 1916, at which time an esophageal hiatus hernia was repaired and a contracted gallbladder remnant containing stones was removed. The common duct, which was about 2 cm. in diameter, was explored but no stones were found. Pathologic examination showed chronic cholecystitis extending into the liver.

The postoperative course was hectic throughout. The temperature varied from 100 to 103° F. Abdominal distention, epigastric pain and ileus were stubborn features of the clinical picture. A tender epigastric mass appeared on the seventh postoperative day. A diagnosis of acute pancreatitis was made. Despite vigorous

therapy, including penicillin, streptomycin and frequent transfusions, her condition deteriorated and she died on November 19, 1916. Necropsy showed marked necrosis of the pancreas with extensive fat necroses throughout the peritoneal cavity.

*Comment.*—Acute pancreatitis complicating the postoperative state following operations on the biliary tract and stomach is an extremely serious matter. Its recognition under these circumstances is particularly difficult and failure to detect it early contributes to the high mortality.

### SUMMARY

The clinical aspects of acute pancreatitis are reviewed.

The importance of the sequential symptomatology in the recognition and anticipation of the many complications of the disease is stressed.

Conservative therapy is recommended.

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## PANCREATIC CYSTS

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Cysts of the pancreas are rare, but measured in terms of diagnostic interest and therapeutic requirement they warrant continued study. Adams and Nishijima reported 9 cases of pancreatic cysts at the Lahey Clinic between 1926 and October 1945. Since that time 7 additional cases have been encountered. This entire group of 16 cases forms the basis of this report.

### CLASSIFICATION

Cysts of the pancreas may be divided into the following types<sup>2</sup>:

1. Retention cysts, which result from obstruction of the duct and are characterized by the presence of an epithelial lining.
2. Proliferative cysts or cystadenomas, which arise from glandular epithelium and are true tumors.
3. Congenital cysts, which are usually multiple and frequently associated with cystic anomalies of other viscera.
4. Pseudocysts, resulting from traumatic or spontaneous necrosis of the pancreas with local accumulation of tissue debris. Pseudocysts are not confined to the substance of the pancreas, are usually devoid of epithelial lining, and are generally limited to the lesser peritoneal cavity.
5. Hemorrhagic cysts are regarded by most observers as a variety of pseudocyst.
6. Hydatid cysts.
7. Dermoid cysts.

### ANATOMICAL LOCATION

The pancreas is a retroperitoneal organ extending from the concave border of the duodenum to the hilum of the spleen. The body of the pancreas is at the level of the first and second lumbar vertebrae. Cysts involving the pancreas usually present through the gastroduodenal or gastrophrenic ligament. Rarely, a cyst may insinuate itself between the leaflets of the transverse mesocolon. Pseudocysts are more varied in their presentation than are true cysts and may point in the flanks or even extend into the pelvis.

### ETIOLOGY

One of several factors may be responsible for the formation of pancreatic cysts. Trauma undoubtedly accounts for certain pancreatic and peripancreatic accumulations, but this etiologic factor has been accorded undue significance in the early literature pertaining to the subject. In many instances in which trauma is accredited, the injury has been trivial and the interval between injury and the appearance



Laboratory data are usually of little aid in the diagnosis, but fasting blood sugar and amylase values should be determined in every instance, and particularly in those cases in which the appearance of the tumor was preceded by an attack of pain suggestive of acute pancreatitis, since disturbances in glucose metabolism will occur in a significant number of such cases.

Roentgenographic studies are helpful in most instances. A flat film of the abdomen may delineate the outline of the tumor. Barium studies of the stomach and colon may demonstrate distortion and displacement of these viscera. If the cyst involves the head of the pancreas there will be widening of the duodenal sweep, demonstrable by the roentgenogram following a barium meal. Retrogastric enlargements may be outlined by roentgenography following injection of air in the stomach, as advocated by Engel and Lysholm. Pyelograms may reveal displacement of kidneys or ureters, but these manifestations must be interpreted with extreme care since they may suggest an origin of the displacing tumor other than the pancreas.

Pancreatic cysts may be confused with retroperitoneal tumors, hepatic enlargements, renal and perirenal masses, mesenteric cysts and gastric tumors.

#### ANALYSIS OF CLINICAL MATERIAL

Pancreatic cysts show a slight predilection for the female sex in a ratio of 9 to 7 in this small series. The ages varied from 18 to 71 years, with a preponderance of patients in the middle-age brackets.

The varieties of tumors encountered included 8 pseudocysts, 2 papillary cystadenocarcinomas, 4 retention cysts and 1 hemorrhagic cyst. Three patients had associated disease of the biliary tract and each one of these presented evidence of clinical jaundice. Gallstones were found in 2 of these individuals. None had common duct stones.

Diabetes mellitus attended the presence of a pancreatic cyst in 3 patients. These cysts were secondary to acute pancreatitis in each instance.

The pancreatic cysts were completely excised in 5 patients.

Simple incision and drainage of the cyst was done in 3 cases, with satisfactory results. Marsupialization was performed in three instances, with recurrence of the cyst in 1 individual, necessitating excision of the cyst along with the tail and body of the pancreas in this instance in order to secure a permanent cure. Cystojejunostomy was performed in 2 patients with satisfactory immediate results. In 2 patients a pancreatic fistula was implanted into the jejunum. One had a recurrent attack of subacute pancreatitis five years later, which may or may not have been related to the type of surgical therapy. The other patient had recurrent persistent pain eighteen months after operation for which bilateral sympathectomy was performed, with excellent symptomatic results. Resection of the head of the pancreas and duodenum was performed in 1 patient, with excellent results.



of the cyst has been long. Many cystic tumors of the pancreas, however, have appeared rapidly after abdominal trauma, and must be accepted as being related directly to the injury (Mayo-Robson).

Pancreatitis, acute and chronic, accounts for the origin of many pancreatic cysts. Pseudocysts, arising from hemorrhagic necrosis of the parenchyma of the gland or representing encapsulated accumulations in the lesser peritoneal bursa, occur as sequelae of acute pancreatitis in about 10 per cent of cases. Chronic pancreatitis produces cystic degeneration, presumably, it is thought, by occluding pancreatic ducts and acini, resulting in accumulation of pancreatic secretions in the obstructed portion of the gland.

Primary obstruction of the pancreatic ducts by biliary or pancreatic calculi, neoplasm, or stricture of the duct system may be responsible for the genesis of some pancreatic cysts.

Congenital cysts are thought to arise from imperfect fusion of the several embryonal elements, resulting in lack of continuity of the acinar and duct systems. They tend to be multiple and frequently are associated with polycystic disease of other viscera.

### SYMPTOMS

*The symptomatology of pancreatic cysts is dependent upon the precipitating factor, the extent, location and the duration of the disease. When the cystic accumulation results from acute pancreatitis, abdominal pain of varying intensity will precede or accompany the tumor. In many instances there are no subjective manifestations. If the cyst appears insidiously, vague abdominal distress and mild dyspeptic symptoms, such as fullness, anorexia and flatulence, may occur. If pain is present it is epigastric in location, with occasional reference to the back.*

*Quite frequently, the patient's only complaint is the presence of a mass in the epigastrium, particularly in retention cysts.*

*In rare instances cysts involving the head of the pancreas may cause obstruction of the common duct or the portal vein.<sup>2</sup> This mass, on examination, will be found in the upper abdomen, usually in the mid-line. It is symmetrical except in cases of cystic accumulations which complicate acute hemorrhagic or suppurative pancreatitis, wherein it may be irregular in outline and may present multiple tumor masses in widely separated areas of the abdomen. Ormond, Wadsworth and Morley presented 3 interesting cases of pancreatic cysts suggesting perinephric abscesses, one of which required simultaneous surgical drainage by way of lumbar and transabdominal routes.*

*The mass is firm and the cyst is usually so tense that fluctuation is difficult to demonstrate by palpation through the abdominal wall. The tumor is relatively fixed but may descend slightly upon deep inspiration. Tenderness may be present in cysts of inflammatory origin.*

Laboratory data are usually of little aid in the diagnosis, but fasting blood sugar and amylase values should be determined in every instance, and particularly in those cases in which the appearance of the tumor was preceded by an attack of pain suggestive of acute pancreatitis, since disturbances in glucose metabolism will occur in a significant number of such cases.

Roentgenographic studies are helpful in most instances. A flat film of the abdomen may delineate the outline of the tumor. Barium studies of the stomach and colon may demonstrate distortion and displacement of these viscera. If the cyst involves the head of the pancreas there will be widening of the duodenal sweep, demonstrable by the roentgenogram following a barium meal. Retrogastric enlargements may be outlined by roentgenography following injection of air in the stomach, as advocated by Engel and Lysholm. Pyelograms may reveal displacement of kidneys or ureters, but these manifestations must be interpreted with extreme care since they may suggest an origin of the displacing tumor other than the pancreas.

Pancreatic cysts may be confused with retroperitoneal tumors, hepatic enlargements, renal and perirenal masses, mesenteric cysts and gastric tumors.

#### ANALYSIS OF CLINICAL MATERIAL

Pancreatic cysts show a slight predilection for the female sex in a ratio of 9 to 7 in this small series. The ages varied from 18 to 71 years, with a preponderance of patients in the middle-age brackets.

The varieties of tumors encountered included 8 pseudocysts, 2 papillary cystadenocarcinomas, 1 retention cysts and 1 hemorrhagic cyst. Three patients had associated disease of the biliary tract and each one of these presented evidence of clinical jaundice. Gallstones were found in 2 of these individuals. None had common duct stones.

Diabetes mellitus attended the presence of a pancreatic cyst in 3 patients. These cysts were secondary to acute pancreatitis in each instance.

The pancreatic cysts were completely excised in 5 patients.

Simple incision and drainage of the cyst was done in 3 cases, with satisfactory results. Marsupialization was performed in three instances, with recurrence of the cyst in 1 individual, necessitating excision of the cyst along with the tail and body of the pancreas in this instance in order to secure a permanent cure. Cystojejunostomy was performed in 2 patients with satisfactory immediate results. In 2 patients a pancreatic fistula was implanted into the jejunum. One had a recurrent attack of subacute pancreatitis five years later, which may or may not have been related to the type of surgical therapy. The other patient had recurrent persistent pain eighteen months after operation for which bilateral sympathectomy was performed, with excellent symptomatic results. Resection of the head of the pancreas and duodenum was performed in 1 patient, with excellent results.

## TREATMENT

A limited number of surgical attacks are available for the management of pancreatic cysts. Each method has some merit and certain limitations. A careful appraisal of the relevant features of the individual case will suggest the proper procedure in each instance.

External drainage (marsupialization) has been the most popular method of treatment in the past. That this procedure is still widely employed indicates that it is effective in many instances, but cumulative experience has shown that marsupialization is followed frequently by recurrent cyst formation or by persistent external fistulas. Drainage from these fistulous openings may persist for many years,<sup>47</sup> and the escaping pancreatic ferments can cause painful erosion about the stoma. Secondary infection of the sinus and recurrent cysts may contribute to the intractability of the drainage.

It is possible to eliminate some of these fistulas by irradiation<sup>48</sup> or by chemical cauterization, thereby destroying the epithelial lining.

It is our belief that marsupialization should be confined to the treatment of patients with pseudocysts of the pancreas which result from pancreatic necrosis, and that external drainage should be employed before these cysts acquire thick, rigid walls or epithelial linings.

The preferred treatment of pancreatic cyst is complete local excision. This can be accomplished in many instances by careful, patient dissection, but may be extremely hazardous from the standpoint of hemorrhage or damage to adjacent viscera. Retention cysts are most amenable to total extirpation because of the relative freedom from inflammatory reaction. Proliferative cysts should be completely excised because of their propensity for malignant degeneration.

Partial pancreatectomy is occasionally more feasible than local enucleation in the treatment of certain pancreatic cysts in which extensive inflammatory reaction and previous surgical trauma have obliterated the natural planes of cleavage. Infrequently, multiple, small inflammatory cysts in the head of the pancreas will simulate carcinoma so closely that partial pancreatoduodenectomy will appear warranted.

Internal drainage, by anastomosing the cyst with the stomach, duodenum or jejunum, has become increasingly popular in recent years. This method is appealing by virtue of its simplicity and relative safety. It should be employed with discrimination in order that more definitive methods of treatment are not relegated to a secondary role in the therapy of pancreatic cysts. One should be particularly on guard against the internal drainage of proliferative cysts of the pancreas which might otherwise be removed completely. Until this method has been employed more extensively, its ultimate merit cannot be truly assessed.

## REPORT OF CASES ILLUSTRATING THE VARIETY OF SURGICAL ATTACK ON PANCREATIC CYSTS

### 1. Excision of Cyst

A woman, 50 years of age, came to the clinic July 17, 1947, complaining of progressive enlargement of the abdomen of three years' duration. There were no associated symptoms. She could feel a firm mass in the upper part of the abdomen.



Fig. 205—Roentgenogram following a barium meal shows displacement and distortion of the stomach by a large cystic mass which fills the greater part of the abdomen.

The patient was well developed, moderately obese and did not appear ill. Her pulse was 70 and her blood pressure 120 mm. systolic and 70 mm. diastolic. There was a large, fixed, firm tumor filling most of the abdominal cavity. The tumor descended slightly during deep inspiration. Some areas of the tumor were more

dense than others but definite fluctuation could not be demonstrated. Routine laboratory examination of the urine and blood showed no abnormalities.

Roentgenologic examination of the abdomen, following a barium meal, demonstrated a large, rounded and well circumscribed mass pushing the stomach anteriorly and superiorly and displacing the duodenum anteriorly and laterally (Fig. 203). The mass extended from the first lumbar vertebra to the crest of the ilium. A diagnosis was made of a retroperitoneal tumor and a pancreatic cyst was considered as one possibility.

The patient was operated on July 29, 1917, at which time a large, multi-loculated pancreatic cyst was completely excised. It involved the greater portion of the body and tail of the pancreas and contained an estimated 1000 cc. of thick grayish fluid. The postoperative course was uneventful. The pathologic report was *pancreatic cyst*.

There has been no recurrence of the cyst and no disturbance in glucose metabolism.

## 2. Marsupialization of Cyst

A man, 39 years of age, came to the clinic in May 1916 complaining of abdominal pain of six years' duration. He consumed large quantities of alcohol and frequently experienced bouts of epigastric pain following periods of excessive drinking. The pain varied in intensity from a dull ache to severe lancinating distress. It extended to each upper quadrant and occasionally to the back. The pain was associated with recurrent nausea and vomiting. He required large amounts of codeine, demerol and morphine for relief. He had lost 28 pounds in weight.

The patient was thin and nervous. The skin was dry and rough. There was a coarse tremor involving the hands and fingers. A large, irregular mass, which did not move appreciably with respirations, was present in the epigastrium.

Roentgenograms of the abdomen showed a mottled area of increased density in the left upper quadrant and epigastrium. Roentgenograms taken after the ingestion of a barium meal showed the stomach to be displaced superiorly by an extrinsic mass. The duodenal curve was widened. A diagnosis of pancreatic cyst and pancreatic calculi was made.

At operation, July 10, 1916, a large cyst was found in the head of the pancreas, adherent to the middle colic artery. The tail of the pancreas was fibrotic and contained numerous calculi. In view of the intimate attachments of the cyst to adjacent viscera, marsupialization was employed. The postoperative course was uneventful except for copious discharge which persisted for four weeks. The patient gained 30 pounds and was free of pain when last examined in the clinic.

## 3. Partial Pancreatectomy

A woman, 30 years of age, was seen in the clinic on April 17, 1917, because of pain in the left upper quadrant of the abdomen of one year's duration. The pain was recurrent, with radiation into the chest and back. Nausea and vomiting were present during the attacks of pain. In August 1916, the patient had had an operation, at which time a pancreatic cyst was found and exteriorized. She remained well following this procedure until January 1917, when the attacks of pain recurred with increasing severity.

Physical examination was negative except for the presence of a firm, cystic mass in the left upper quadrant of the abdomen. Roentgenograms of the stomach showed a large mass impinging on the lesser curvature of the stomach.

A diagnosis was made of recurrent pancreatic cyst and operation was performed on July 19, 1917. A large cyst involving the body and tail of the pancreas was encountered. The cyst was marsupialized. Drainage persisted intermittently until October 21, 1917, when the patient was readmitted to the hospital and the body and tail of the pancreas and the spleen were removed. The postoperative course was excellent. There has been no recurrence of drainage and no reaccumulation of the cyst.

#### 4. Anastomosis of Pancreatic Cyst to Jejunum

A man, 45 years of age, was examined at the clinic on February 2, 1914. He complained of intermittent abdominal pain of three years' duration. A severe attack of pain, associated with jaundice, had occurred three weeks before his visit to the clinic. He had lost 30 pounds in eight weeks.

Physical examination revealed no unusual findings. A suspicion of diabetes mellitus was confirmed by the demonstration of an abnormal glucose tolerance curve.

Cholecystograms were normal. The duodenal sweep, as delineated by roentgenograms following a barium meal, was widened.

At operation February 1, 1914, a cyst was found arising from the head of the pancreas. This cyst was anastomosed to the jejunum approximately 35 cm. from the ligament of Treitz. An enteroenterostomy between the afferent and efferent loops of the jejunum completed the procedure. The postoperative course has been satisfactory.

#### 5. Pancreatoduodenectomy

A man, 51 years of age, was examined at the clinic on June 24, 1917. He complained of severe epigastric pain which had been present almost constantly for six months. It was particularly severe at night. For two months before his visit to the clinic he had repeated attacks of nausea and vomiting and had lost 30 pounds in weight during the same interval. He had had periodic bouts of epigastric pain for several years prior to his current illness.

The patient was thin and emaciated and in obvious pain. He weighed 96 pounds. Physical examination was negative except for the abdominal findings. Muscle spasm and tenderness were present in the right upper quadrant of the abdomen. No masses were palpable.

Routine urinalysis and blood counts were normal. Gastric analysis showed an absence of free acid and a total acid of 20.

There was nonvisualization of the gallbladder following the Graham-Cole test. Roentgenograms of the stomach following a barium meal revealed pylorospasm but no duodenal defect. The barium enema was negative.

The preoperative diagnosis was carcinoma of the pancreas. On July 22, 1917, operation was performed. There was a diffuse, firm enlargement in the head of the pancreas which was grossly indistinguishable from malignancy. No other abnormalities were observed in the abdomen. A radical pancreatoduodenectomy was done, with choledochojejunostomy, pancreatojejunostomy and gastroenterostomy, restoring the continuity of the digestive tract. The postoperative course was without incident.

The pathologic findings included focal inflammation of the duodenal wall and adjacent pancreas. Medial to the stump of the common duct there was a cystic

cavity in the substance of the pancreas, measuring 2 cm. in diameter and filled with brown fluid. No malignancy was demonstrated.

The patient was examined eight weeks following operation, at which time he was completely free of symptoms and had gained 16 pounds.

### SUMMARY

The clinical and pathologic features of pancreatic cysts are discussed. Data relating to 16 cases are presented.

Individualization in surgical treatment of the lesion is recommended.

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# A TECHNIC FOR PANCREATODUODENAL RESECTION

RICHARD B. CATTELL

INCREASING numbers of patients have been submitted to resection of the head of the pancreas for carcinoma in this general area. This includes resection for carcinoma of the ampulla, carcinoma of the head of the pancreas and carcinoma of the lower end of the common bile duct as well as an occasional carcinoma arising in the mucosa of the second portion of the duodenum. Of these malignancies, carcinoma of the head of the pancreas is somewhat more frequent. During an early stage, carcinoma of the head of the pancreas can usually be demonstrated to have arisen from the pancreatic ducts. In the more advanced cases, particularly in autopsy findings, with the spread of the lesion the point of origin cannot be determined. Malignancies in the pancreatoduodenal area comprise between 1 and 2 per cent of all malignancies, so that the total experience in the surgical management of these lesions has been somewhat limited when compared to carcinoma of the stomach or carcinoma of the large intestine. A large number of reports is now available in the literature for review which demonstrate clearly that the operation is technically feasible. A further long period of follow-up will be necessary to judge the efficacy of these procedures.

A number of technics for pancreatoduodenal resection, both in one and in two stages, has been described since the original report of Whipple, Parsons and Mullins<sup>18</sup> in 1935, which was a two-stage operative procedure. Trimble, Parson and Sherman described a one-stage procedure in 1941, with a successful outcome. In addition, reports by Hunt and Budd, Brunschwig, Hunt, Harvey and Oughterson, Orr,<sup>10-12</sup> additional communications by Whipple,<sup>15-17</sup> and the author<sup>2-8</sup> have described different technics and results. Pearse more recently called attention to the need of standardization of these procedures.

The essential feature of a suitable operative procedure for pancreatoduodenal resection emphasized originally by Whipple and his associates<sup>18</sup> is the plan for a block resection of the head of the pancreas, lower end of the common duct, pylorus of the stomach and the duodenum. In the performance of the operation, the biliary tract, gastrointestinal tract and pancreas are interrupted. Restoration of the biliary tract is best accomplished by the anastomosis of the common duct or common hepatic duct to some portion of the gastrointestinal tract, although in the two-stage operation it can be accomplished satisfactorily by anastomosis of the gallbladder. The gastrointestinal tract can be restored by end-to-end or end-to-side gastrojejunostomy.

The author early called attention to the importance of the anastomo-



sis of the main pancreatic duct in carrying out these resections. Although in the earlier experience of Whipple and in the case reported by Trimble the pancreatic ducts were closed, demonstrating that this *is consistent with recovery*, I pointed out that there were fewer complications postoperatively when the duct was anastomosed. This reduces the incidence of pancreatic fistula, peritoneal infection and postoperative hemorrhage. Furthermore, the return of the external secretion of the pancreas to the intestine is an important aid in proper utilization of protein and fats. It is generally agreed today that the anastomosis of the pancreatic duct should be done routinely during pancreatoduodenal resection.

If the pancreatic duct is not dilated its anastomosis may be technically difficult. This can be overcome by the technic which I described<sup>14</sup> in which a closed anastomosis by means of a pressure necrosing suture joins the duct to the jejunum. If the duct is dilated, it can be anastomosed without difficulty over a tube in a similar fashion to the choledochojejunostomy.

In our experience, between 25 and 30 per cent of the malignant lesions in the peri-ampullar region can be resected. Carcinoma arising in the ampulla is the most favorable, while carcinoma of the head of the pancreas, of the duodenum and of the common bile duct are more likely to show spread beyond the limits of possible resection.

#### CONTRAINDICATIONS TO RESECTION

As one's experience increases with the management of these lesions it becomes apparent that resection of advanced malignant disease in this area is not worth while, both because of the technical difficulties involved and also because of the short duration of life under these circumstances. We have found that if the line of resection passes through an area involved by malignancy, even though a satisfactory postoperative recovery follows, diffuse abdominal metastases will be found within a few weeks or months. For this reason and also because of the very extensive operative procedure necessary, resection should be confined to the favorable lesions. We consider four findings a contraindication to operation: (1) distant metastases; (2) local spread with direct invasion beyond a possible limit of resection; (3) involvement of the superior mesenteric vessels, and (4) involvement of the portal vein.

During the abdominal exploration one should carefully search for evidence of metastases. In some cases it will be necessary to biopsy the liver and examine a frozen section since in some patients with negative palpation of the liver and negative inspection, microscopic metastases may be demonstrated on frozen section. Biopsy of nodes along the hepatic artery, or of those at the superior aspect of the pancreas and below the common duct may be important. Direct invasion or local spread may be demonstrated in the region of the

gastroduodenal artery or posteriorly in the region of the inferior vena cava. Unless the area can be elevated beyond the malignancy, resection should not be done. The involvement of the superior mesenteric vessels can be determined by division of the gastocolic omentum and incision of the peritoneum on the inferior border of the pancreas. Similarly, the portal vein can be identified by division of the gastroduodenal artery and displacement of the common duct downward, permitting digital examination of the posterior surface of the head of the pancreas, displacing the portal vein backward. If the portal vein is involved, resection is contraindicated.

### PALLIATIVE OPERATIVE PROCEDURES

Relief of the obstructive jaundice by anastomosis of the biliary tract to the gastrointestinal tract has long been considered to be the sole palliation possible. The immediate relief of the obstructive jaundice by an operation such as cholecystojejunostomy is very striking and a welcome relief to the patient of the accompanying pruritus. In most cases, however, this relief is quite temporary, as demonstrated by the follow-up results. In a consecutive series of 56 patients who had cholecystojejunostomy usually with jejunojejunostomy, performed in this clinic, 75 per cent were found to be dead nine months after the onset of their obstructive jaundice, or an average of six months after the biliary tract anastomosis. The relief of the obstructive jaundice does not greatly improve the nutritional state of the patient if complete block of the pancreatic ducts persists. For this reason, when the duct of Wirsung is found to be dilated we recommended a side-to-side anastomosis of the duct of Wirsung to the jejunum just proximal to the cholecystojejunostomy. The technic of this was described in the *Surgical Clinics of North America* in June 1917.<sup>6</sup> We have now performed this anastomosis in 22 patients, with no immediate hospital mortality.

One can consider four palliative procedures for inoperable carcinoma of the head of the pancreas: (1) cholecystojejunostomy with entero-enterostomy; (2) pancreatojejunosomy; (3) ligation of the gastroduodenal artery and inferior pancreatoduodenal artery, and (4) gastrojejunosomy.

Cholecystojejunostomy need not be discussed further. In our experience it is better to anastomose the gallbladder to the jejunum rather than to the stomach or to the duodenum. Large amounts of bile are not tolerated well in the stomach. Anastomosis of the gallbladder to the duodenum should not be done because of its proximity to the malignant lesion. When the gallbladder is anastomosed to an antecolic loop of jejunum it places the anastomosis at the greatest distance from the malignancy and is less likely to become involved early by extension of the malignant disease. If the gallbladder has been removed previously,

a side-to-side anastomosis of the common duct or common hepatic duct to the jejunum is performed.

A side-to-side anastomosis of the duct of Wirsung to the jejunum is not technically difficult. A point is selected on the jejunum about 3 or 4 inches (7.5 or 10 cm.) proximal to the cholecystojejunostomy and a direct anastomosis done over a T-tube, as previously described.<sup>4</sup>

An enteroenterostomy is done in all cases of cholecystojejunostomy alone or when cholecystojejunostomy and pancreatojejunostomy have been done.

It is impossible to prove what effect reduction of the blood supply to an inoperable tumor accomplishes. The gastroduodenal artery is the source of the major arterial supply to the head of the pancreas. In most cases identification of the hepatic artery and the gastroduodenal artery can be done and ligation of the latter structure with or without division carried out. We have done this a number of times in inoperable cases and in a few have combined it with ligation in continuity of the inferior pancreatoduodenal artery. From a theoretical point of view it may possess some value.

In a few patients with inoperable carcinoma in this area, the duodenum already shows evidence of obstruction. Under these circumstances a gastrojejunostomy is performed. This can be done in conjunction with the other three procedures and it makes an enteroenterostomy unnecessary since the stomach can be anastomosed to the efferent loop of jejunum beyond the pancreatic and gallbladder anastomoses.

#### CONFIRMATION OF THE DIAGNOSIS

A discussion of the diagnosis of cancer of the head of the pancreas is not pertinent to this paper. With few exceptions, a gradually increasing painless obstructive jaundice is present. The liver is enlarged and the gallbladder will usually be palpable. On exploration, the gallbladder and common bile duct will be found to be markedly dilated. In over half the cases, the duct of Wirsung is dilated and can be readily palpated through the gastrohepatic omentum. This can be felt in the mid portion of the body of the pancreas as a longitudinal cystic structure at the junction of the middle and upper thirds of the pancreatic body. If no tumor can be palpated at the ampulla or in the head of the pancreas, the finding of dilatation of the biliary tract or dilatation of the duct of Wirsung may be the only means of establishing the diagnosis. In the very early lesions originating in the head of the pancreas in one of the main pancreatic ducts only dilatation of the duct of Wirsung may be found. Under most circumstances the diagnosis of carcinoma in this location cannot be established by biopsy. Biopsy of the head of the pancreas is rarely of help in establishing the diagnosis as a frozen section report will usually show only chronic pancreatitis. Biopsy of ampullar lesions can be accomplished by the transduodenal

approach, but is not necessary as they can be readily felt through the duodenal wall. The biopsy of any regional nodes that show enlargement may be of help. Small tumors in the head of the pancreas may be felt after elevation of the duodenum and head of the pancreas. With few exceptions in our experience, it was necessary to proceed with resection without positive histologic diagnosis, but it should be emphasized that resection is not proceeded with unless dilatation of either the pancreatic ducts or biliary tract can be demonstrated.

#### DETERMINATION OF OPERABILITY

In the deeply jaundiced patient, particularly those who have a history of several weeks of obstructive jaundice, exploration should be limited to palpation and possibly liver biopsy. An antecolic cholecystojejunostomy should be performed as the sole procedure since any extensive dissection of the operative field causes adhesions and makes the second stage resection more difficult. If this opinion is accepted it may be found in some cases that at a second stage exploration in two or three weeks the lesion may be found to be inoperable, resulting in two operations without resection. Under these circumstances it may be feasible to do anastomosis of the duct of Wirsung as well as the enteroenterostomy at this time. If the condition of the patient warrants a one-stage pancreatoduodenal resection, one proceeds to establish the diagnosis as outlined above and also to determine the operability. Fortunately, one can determine operability without being committed to resection and before interruption of either the gastrointestinal, biliary or pancreatic tracts. Thus, division of the gastrocolic omentum on the right side with demonstration of the superior mesenteric vessels and inferior border of the pancreas, division of the gastrohepatic omentum with ligation and division of the right gastric and gastroduodenal arteries permit exposure of the portal vein but do not make resection mandatory. With division of the peritoneum on the right side of the duodenum and elevation of the pancreatic head, posterior invasion or fixation can likewise be determined. At this stage in the operation one can at least demonstrate whether the resection is technically feasible, irrespective of the size of the tumor.

#### ONE-STAGE VERSUS TWO-STAGE OPERATION

There is an increasing trend for the selection of a one-stage operation for pancreatoduodenal resection. Whipple,<sup>14</sup> Trimble, Brunschwig, Waugh and others favor it. Without question, it is an easier operation technically; furthermore, the first stage operation does not reduce the magnitude of the second-stage procedure. Its sole object is to accomplish relief of the obstructive jaundice, with the resultant improvement in liver function. Whipple emphasized that with a careful preoperative preparation, blood replacement and the use of synthetic vitamin K, a two-stage operation is not necessary. It is my opinion that a two-

stage operation should be done in any patient who has a severe obstructive jaundice, particularly if it has been present for several weeks. Unfortunately, it is not possible to determine liver function accurately by the use of liver function tests in the presence of obstructive jaundice. If there is marked enlargement of the liver which is an accompaniment of obstructive jaundice, the patient is a poor candidate for one stage resection. Cholecystojejunostomy can easily be performed with only a short period of preoperative preparation and can accomplish much more so far as liver function goes than can be accomplished by a long period of medical preparation. Fortunately, a first stage procedure can be done which does not add materially to the technical difficulties of the second stage. This is not true of the early two-stage procedures which have been utilized. If a site is selected on the jejunum for the cholecystojejunostomy 15 to 18 inches (37.5 to 45 cm.) from the ligament of Treitz and this loop brought up in an antecolic position, one can displace it easily downward at the second stage procedure without adding to the technical difficulties. In our experience, in two thirds of the patients submitted to resection the operation has been done in two stages while in only one third it has been completed at the initial operation.

#### TECHNIC OF PANCREATODUODENAL RESECTION

**Steps of the Procedure.**—The steps of the procedure will be listed in the order in which they are carried out and then later described. This order of operation is chosen because it permits one to establish the diagnosis and determine operability without committing the surgeon to the radical procedure. It enables one to establish the contraindications to operation and also permits the four possible procedures, including pancreatojejunostomy in the inoperable cases.

#### TWO-STAGE PANCREATODUODENAL RESECTION

1. Exploration.
2. Biopsy of lymph nodes and liver
3. Elevation of the duodenum and head of the pancreas
  1. Division of the right half of the gastrocolic omentum
5. Freeing of the hepatic flexure and right half of the transverse colon
6. Exposure of the superior mesenteric vessels at the inferior border of the pancreas
7. Division of the gastrohepatic omentum
8. Ligation and division of the right gastric artery, anterior duodenal artery and gastroduodenal artery
9. Exposure of the portal vein and superior border of the body of the pancreas
10. Division of the common duct (closure of the common duct)
11. Division of the stomach in the prepyloric area

12. Division of the body of the pancreas (closure of the pancreas except the duct)
  13. Division of the jejunum (freeing of the proximal jejunal mesentery)
  14. Delivery of proximal jejunum and fourth portion of the duodenum to the right of the superior mesenteric vessels
  15. Freeing of the uncinate process and division of the branches of the superior mesenteric artery and vein
- This permits removal *en bloc* of the resected specimen.

#### Steps in the Reconstruction

16. Pancreatojejunostomy (anastomosis of the duct of Wirsung to the jejunum)
17. Choledochojejunostomy (end-to-side) if needed
18. Jejunojejunostomy
19. Gastrojejunostomy
20. Insertion of cigaret drain and wound closure

The technic of the two-stage pancreatoduodenal resection will be described in detail. The only difference in the second stage procedure and a one-stage pancreatoduodenal resection is the first stage anastomosis of the gallbladder to the jejunum, and at the second stage this anastomosis is displaced downward, as shown in Figure 207. A second variation is the method of dealing with the common bile duct. The common bile duct will usually be inverted as one inverts the duodenal stump in subtotal gastrectomy, or if the cystic duct enters near the point of division, the common duct will be anastomosed just as in a one-stage procedure in addition to the previous anastomosis to the gallbladder.

The completed first-stage operation is shown in Figure 206. A long loop of jejunum, 15 to 18 inches (37.5 to 45 cm.) from the ligament of Treitz, is brought up in an antecolic position and anastomosed in two layers to the full width of the gallbladder. This anastomosis is done with interrupted sutures of silk on the outside and either a continuous locked, fine chromic catgut suture or interrupted fine chromic catgut sutures used for the inner layer. The enteroenterostomy, as demonstrated, is optional. It is not necessary at the first stage.

The second stage of the procedure is carried out by reopening the first incision and lengthening it. The previous anastomosis is freed up and displaced to the right and downward (Fig. 207). The peritoneum over the kidney is incised to the right of the duodenum and the duodenum and head of the pancreas are elevated and rotated to the left. This will expose on the posterior aspect of the abdomen in turn the spermatic or ovarian vein, the inferior vena cava and the aorta.

The lesser omental sac is entered through the anterior two layers of the gastrocolic omentum at the extreme right margin. The posterior portion of the gastrocolic omentum is then displaced downward, identifying the middle colic vessels, and the peritoneum is incised to

the right, freeing the hepatic flexure and right half of the transverse colon and displacing it downward (Fig. 207). The peritoneum is then incised at the inferior border of the pancreatic body, exposing the superior mesenteric vein. The superior mesenteric artery is next identified and the inferior pancreaticoduodenal artery ligated and divided.

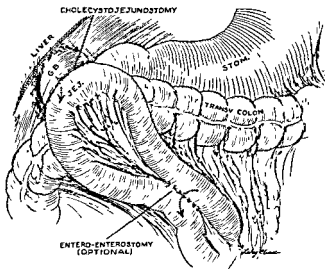


Fig. 206 —First stage operation. A long loop of jejunum has been drawn up in front of the colon and a wide side-to-side anastomosis completed between the gallbladder and the jejunum. Enteroenterostomy is optional at the first stage procedure.

The lower half of the gastrohepatic omentum is incised, the right gastric artery ligated and divided and the course of the hepatic artery determined. The gastroduodenal artery is identified where it leaves the hepatic artery. It will be found to have a very short trunk before it divides, usually into four branches. This allows about 1 cm. of the artery to be dissected free and divided between ligatures.

The common duct is then freed up and the site of entry of the cystic duct exposed. The common duct is displaced downward and the anterior surface of the portal vein visualized (Fig. 208). A finger can be passed under the head of the pancreas on top of the portal vein which has no branches and the finger passed through so as to emerge below the body of the pancreas anterior to the superior mesenteric vein. Careful palpation of the entire region can at this time determine the operability of the lesion before division of either the stomach or common bile duct.

The common duct can now be divided between clamps at the proper point. This will vary greatly depending upon the site of the malignancy. If the first stage operation has been done and the cystic duct found too close to the desired point of resection, the common duct is severed and left for implantation into the jejunum beside the cholecystojejunostomy. In a rare instance it will be found necessary to remove the

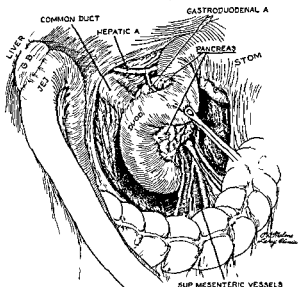


Fig. 207.—Second stage operation. The cholecystojejunostomy has been displaced downward and to the right. The gastroduodenal omentum has been divided, exposing the head of the pancreas, superior mesenteric vessels and third portion of the duodenum. The duodenum and head of the pancreas have been elevated. The common duct has been exposed and the gastroduodenal omentum divided. The course of the hepatic artery and of the gastroduodenal artery are shown.

gallbladder and disconnect the cholecystojejunostomy. In the two-stage procedure when the cystic duct is not near the point of division, the common duct is carefully turned in by inversion sutures, using silk for the outer layer.

The pyloric end of the stomach is then freed of its vascularity and clamps placed across it usually  $1\frac{1}{2}$  to 2 inches (3.7 to 5 cm.) proximal to the pylorus (Fig. 209). The proximal clamp on the stomach can be placed within the abdominal cavity on the left side of the abdomen which leaves the entire anterior surface of the body of the pancreas exposed.

The body of the pancreas is now lifted up on the finger and a point selected for transection of the pancreas (Fig. 209). The main arterial blood supply of the pancreatic body runs along the superior and inferior aspects as longitudinal pancreatic arteries. Suture ligatures are placed



on both superior and inferior aspects of the pancreas utilizing non-absorbable suture material, enclosing about 1 cm. of the pancreas. These are used in the distal portion of the pancreas near the line of resection. The pancreas is then transected, controlling bleeding from the proximal side with Allis clamps. The duct of Wirsung is dissected out before complete division and left to project from the cut surface of the pancreas. This division exposes the portal vein and the junction

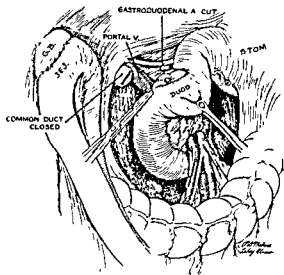


Fig. 208.—The gastroduodenal artery has been ligated and divided, the common duct divided and the proximal end carefully inverted. The portal vein has been exposed.

of its tributaries, the superior mesenteric and splenic veins. The pancreas is then closed with interrupted mattress sutures of silk, leaving the duct of Wirsung open. If the duct is dilated, a catheter of appropriate size is placed in it; if the duct is small it is ligated with fine plain catgut and then the duct is transfixed behind the tie, passing halfway through the duct with a braided silk suture. The portion of the pancreas remaining is then displaced to the left.

The transverse colon is raised and a point selected for division of the jejunum about 7.5 cm. distal to the ligament of Treitz. The ligament of Treitz is completely severed, freeing up the proximal jejunum and fourth portion of the duodenum. The mesentery of the proximal jejunum is then divided and the vessels ligated. The jejunum is divided between clamps (Fig. 209) and the proximal end is closed, leaving the sutures long for traction.

The division of the ligament of Treitz, freeing the proximal jejunum

beneath the superior mesenteric vessels, makes a free communication between this area and the dissection previously carried out on the right side of the abdomen. The proximal jejunum and the fourth portion of the duodenum are drawn through beneath the superior mesenteric vessels to the right.

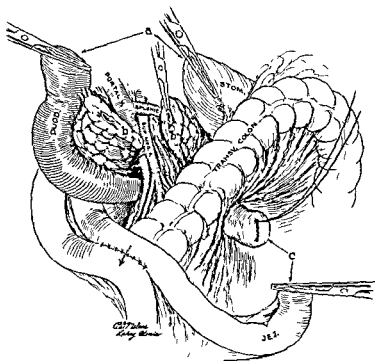


Fig. 209.—a, The stomach has been divided in the prepyloric area. b-b, The body of the pancreas has been divided, securing the duct of Wirsung. c, The jejunum has been divided and the ligament of Treitz freed.

By elevation of the duodenum and head of the pancreas, the uncinate process can be freed up posteriorly. This is the most difficult part of the operative procedure. By elevation of the pyloric end of the stomach, head of the pancreas and duodenum, the short branches of the superior mesenteric vein and superior mesenteric artery that go to the head of the pancreas, the uncinate process, the fourth and third portions of the duodenum, are then divided between clamps, permitting delivery of the specimen. Sheets of gelfoam or oxidized cellulose (oxycel) may be useful in the control of capillary ooze.

A point is then selected on the afferent loop of jejunum for the anastomosis of the pancreatic duct. If the duct is small, a pressure necrosis suture technic is used, as previously presented.<sup>2,3</sup> Usually

the duct of Wirsung will be large enough to permit careful suture over a rubber tube. The mesenteric surface of the jejunum at the point selected is incised for the same distance as the width of the cut closed end of the pancreas. The jejunum is sutured to the pancreas with interrupted silk sutures, passing through the area previously closed by the mattress sutures of the pancreas to prevent the sutures pulling out. When the posterior suture line has been completed, the mucosa of

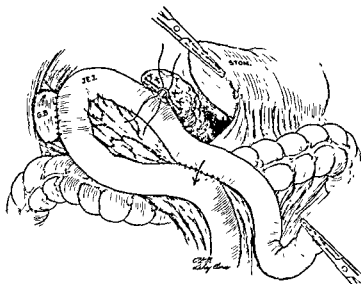


Fig. 210.—Pancreatojejunostomy The cut end of the pancreas has been closed with interrupted mattress sutures. The seromuscular coat of the jejunum has been incised. Two-layer anastomosis of the duct of Wirsung and pancreas to the jejunum is being completed over a tube.

the jejunum is opened and two interrupted sutures of catgut taken between the mucosa of the duct and the mucosa of the jejunum. A rubber tube is then inserted and anchored with a silk suture. Two interrupted sutures are taken in the mucosa anteriorly and the anastomosis completed by interrupted silk sutures through the anterior wall of the jejunum and pancreas (Fig. 210).

In the two-stage procedure, the biliary tract anastomosis will have been completed by the first stage cholecystojejunostomy. In some cases it will be necessary to implant the common bile duct into the jejunum as an end-to-side procedure just proximal to the gallbladder. This is the same anastomosis as carried out in the one-stage procedure, and is done in two layers over a rubber tube.

If the enteroenterostomy was not done proximal to these anastomoses at the first stage procedure, it is done as the third anastomosis.

The final procedure is an end-to-end anastomosis of the stomach to the jejunum.

A cigaret drain is placed down to the region of the resected uncinate process and brought out between the biliary and pancreatic anastomoses through the upper portion of the wound. The usual completed second stage procedure is illustrated in Figure 211.

Since 1939, 52 pancreatoduodenal resections for carcinoma have been performed at the Lahey Clinic. Two thirds have been performed

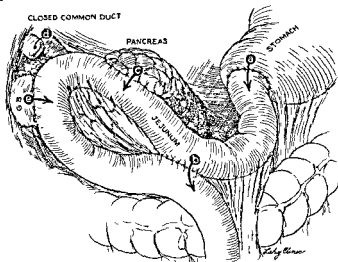


Fig. 211.—The completed pancreatoduodenal resection. All anastomoses are antecolic: a, End-to-end gastrojejunostomy, b, enteroenterostomy, c, pancreaticojejunostomy; d, closed end of the common duct, e, cholecystojejunostomy.

in two stages with little variation in the technic described, while one third have been performed as a one-stage operation. There were 9 hospital deaths, a mortality of 17.3 per cent. From this experience we have learned that a number of resections have been performed in our cases with findings that we now believe contraindicate operation. It is our belief that the two-stage operation is an important aid in maintaining a lower operative mortality.

The anastomosis of the pancreatic duct in all cases is an important part of a successful operative procedure. It has been performed with one exception in all pancreatoduodenal resections carried out in this clinic. The one patient in whom duct anastomosis was not done was the first to have this operation. All of these anastomoses of the duct of Wirsung were done as end-to-side, either by the pressure necrosing suture technic or by open anastomosis. Thus, 51 anastomoses of the duct have been carried out in resected cases, with but one known failure. The failure occurred in a patient who had an unfavorable

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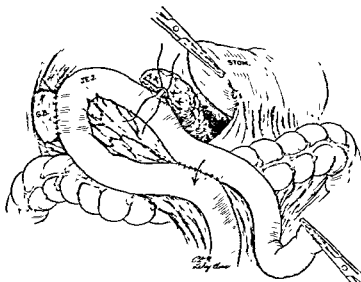


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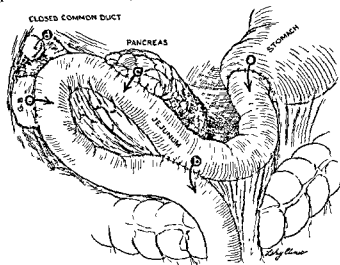


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lesion with diffuse local nodular metastases and was due to a technical fault. No enteroenterostomy had been performed and it is believed that the loop of jejunum became distended. Death occurred and autopsy was performed on the ninth postoperative day. There was partial separation of the pancreatoduodenal anastomosis with localized peritonitis. In addition to these end-to-side pancreatojejunostomies, 22 side-to-side anastomoses of the duct to the jejunum have been done in inoperable cases. In no instance has a biliary tract anastomosis failed in resected cases. One patient during the immediate postoperative period had delay in emptying of the stomach. This patient had obstruction of the gastrojejunostomy and on the eighteenth day after operation, the opening in the gastrojejunostomy was enlarged by a Heineke-Mikulicz type of plastic operation on the anastomosis. Recovery was uneventful subsequently. A similar obstruction to the gastric outlet occurred in one other patient who was reoperated upon at a second hospital admission by a similar procedure, and made an uncomplicated recovery.

From this experience we believe that this technic of a two-stage pancreatoduodenal resection can be demonstrated to be an effective one for reestablishment of the gastrointestinal, biliary and pancreatic tracts.

#### SUMMARY

Experiences with pancreatoduodenal resection for carcinoma of the ampulla, head of the pancreas, duodenum and common bile duct are presented. The importance of selecting a two-stage resection in the majority of patients is emphasized. A first stage procedure of cholecystojejunostomy does not add materially to the technical complications of the second stage procedure and does permit rapid improvement of liver function by the relief of obstructive jaundice.

Palliative procedures are discussed. In addition to the conventional cholecystojejunostomy for the relief of obstructive jaundice, side-to-side anastomoses of the duct of Wirsung to the jejunum have been performed, relieving the obstruction of the pancreatic ducts and restoring the pancreatic ferments to the intestinal tract. It has been carried out in 22 patients without hospital mortality.

Steps in a two-stage pancreatoduodenal resection are enumerated and the procedure described. Attention is called to the feasibility of anastomosis of the duct of Wirsung by two different techniques in resected cases.

Fifty-two pancreatoduodenal resections have been performed since 1912, with 9 deaths, an operative mortality of 17.3 per cent.

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## MISCELLANEOUS SUBJECTS

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### HABITUAL PREPYLORIC SPASM

MARTIN L. TRACEY

PREPYLORIC spasm and its differentiation from organic lesions constitute one of the most difficult and confusing diagnostic problems. This discussion is concerned not so much with the temporary spasm that can be dispelled by stringent medical treatment. This temporary spasm changes from x-ray film to x-ray film and from one check-up appointment to another. We are concerned rather with the habitual, unremitting spasm that persists with little or no change over a period of months and through many roentgenologic examinations.

After the history and physical examination which point to an upper gastrointestinal investigation, the use of the roentgen-ray examination is most helpful. The physical examination is not usually positive with prepyloric lesions because this region is frequently covered by the rib margins. When the roentgenologist has demonstrated any distortion of the prepyloric area that is not clearly neoplastic, such a finding demands certain maneuvers for further information: (1) repeated roentgenographic studies; (2) gastroscopy and (3) therapeutic trial.

In repeating the roentgenologic examination with foreknowledge of a prepyloric lesion, a small amount of barium mixture (a teaspoonful or a small mouthful) should be used. The patient is examined, using this small amount of contrast medium, in the erect, prone and supine positions, turning the subject of examination in all angles under fluoroscopic control so that the best position for films and spot-pressure technic may be determined.

One of the most helpful and most often used positions which merits special and separate discussion is the supine position with the patient turned up toward the left side, the right side facing the fluoroscopic screen. This displaces the fundal air bubble into the antrum and prepyloric areas and, with whatever barium remains clinging to the folds, enables one to get an *air contrast* film of this region. With proper exposure and pressure technic we have found this maneuver most important in searching for small craters and small filling defects in the prepyloric area. The upper edge of a filling defect may be seen as a line with this maneuver. Every roentgenologist has had the experience of wishing that he had not given the full glass of barium until he had made special films of a certain gastric area. This hardly holds for the prepyloric area as one can always obtain a mucosal relief study by the use of the above technic. The full glass of barium may always be displaced into the fundus to free the prepyloric area for inspection by use of the right oblique supine position.

The prepyloric area has attained a singularly bad reputation for malignant lesions. Consequently, the physician who cares for a patient with a lesion in this region has assumed considerable responsibility when he carries such a patient on medical treatment.

It has long been felt that persistent spasm in the prepyloric area is the result of small mucosal erosions not visible by roentgenologic examination. *Gastroscopy* has been disappointing because this area is often seen from a difficult angle and the peristaltic action above the habitual spasm travels down to the spastic area where the latter often mimics a pyloric sphincter muscle. It is, therefore, impossible to be sure that the true pyloric sphincter has been seen. Small ulcerating lesions high on the posterior wall of the prepyloric area near or at the lesser curvature are not visible because the angulus overhangs this region. Gastroscopic examination is done, therefore, to attempt visualization but it is only helpful if positive. A negative gastroscopic examination does not exclude a lesion.

Rather persistent prepyloric spasm may be associated with a posterior wall ulcer in the body of the stomach and careful search should be made for such a lesion. Acute inflammatory disease in the gall-bladder, cholelithiasis and pancreatitis may be the cause of such spasm. The absence of hydrochloric acid from the gastric juice makes early decision regarding exploratory laparotomy mandatory, especially if the roentgenogram or gastroscopy, or both, suggest an ulcerating or neoplastic lesion as the origin of such spasm. The presence of hyperchlorhydria may, in conjunction with spasm, present an ulcer-like syndrome. The finding of hyperchlorhydria may make the clinician feel a little more secure but it is a very dangerous criterion for use as a decisive factor.

In the absence of pathognomonic crater (niche) or neoplastic findings, we always resort to a *therapeutic trial*. Relief of spasm is best accomplished by *bed rest and ulcer management in the hospital*. Criteria favoring benignity of the spasm are best established in such surroundings. These criteria are: complete freedom from distress, absence or disappearance of occult blood from all stools and complete resolution of the defect. If all these criteria are satisfied, the physician can feel secure that the spasm was functional or the result of small, undetected ulceration.

Cases about to be presented have been chosen because after investigation such as mentioned above, they fulfilled all criteria except complete disappearance of the persistent deformity. This small but thought-provoking series with unchanging prepyloric spasm has been proved benign (with one exception) by exploration, gastroscopy and prolonged follow-up.

#### REPORT OF CASES

CASE 1 (the exception mentioned) — A woman, aged 33 years, was first seen in 1931. She had no upper gastrointestinal complaints but in a routine series the

roentgenogram showed slight spasm at the pylorus. At subsequent check-up examination, February 1938, the roentgenogram revealed a "prepyloric area appearing somewhat rigid but waves are seen to pass through and the deformity appears to be due to adhesions rather than to any organic defect." Achlorhydria was noted.



Fig. 212 (Case 1).—Roentgenogram taken just prior to negative exploratory laparotomy June 1, 1944

The patient was readmitted May 5, 1944, because of attacks of pain in the right upper quadrant, extending to the interscapular area. She had one attack monthly for about ten years and four severe attacks during the past four months. Cholecystectomy had been performed in 1927 for noncalculous cholecystitis.

On physical examination, the patient was pale and tired appearing. The hemoglobin was 11.2 gm. and erythrocytes numbered 3,800,000. The roentgenologist's report was similar to that of 1938, but the impression was "could be due to carcinoma or adhesions" (Fig. 212).

The gastroscopist's report was, "Antrum redder than normal, tapers to a point and no peristalsis observed to pass through this region. No normal rugae.

Impression: lesion of infiltrative malignant type because (1) *no peristalsis*; (2) *color change in mucosa*, and (3) *no rugae in this region*."

Exploratory laparotomy was done June 1, 1941. The operative findings were "large amount of adhesions at the lower end of the stomach with pylorus and duodenum attached to the abdominal wall."



Fig. 213 (Case 1).—Roentgenogram taken just prior to resection, with pathologic diagnosis of "mucinous carcinoma"

Postoperatively, the patient had occasional mushy stools and right upper quadrant pain. In October 1945 she first mentioned high epigastric pain occurring directly after eating and developed fear of eating. Weight was 131½ pounds. There was a similar defect roentgenologically.

Eight months later she had more or less constant high epigastric ache with constipation. Physical examination and blood counts were normal. There was achlorhydria and a similar roentgenographic deformity.

With three check-up examinations and roentgenologic examinations between June 1946 and September 29, 1947, there was little change in the patient's general condition. She was reasonably comfortable, blaming her distress on the pressure of business and emotional upsets.

On September 29, 1947, the x-ray report was "a constricting defect distal one-third of stomach. Waves never passed through. On proximal end of the constriction there is a suggestion of an overhanging defect. Spot pressure films of this area show negative shadows suggesting polypoid growth. Suggest annular constricting neoplasm. Normal duodenum" (Fig 213).

Because of acute pharyngitis and tracheitis, operation was postponed until November 6, 1947, at which time she had operative findings of "extensive carcinoma involving pylorus but no extension beyond. The liver was grossly negative. One lymph node in the region of the left gastric artery appeared pathologic." Subtotal gastrectomy was carried out. The pathologic diagnosis was "mucinous carcinoma with metastasis to four of ten lymph nodes."

CASE 2.—A woman, age 58 years, had an attack of pain in the left upper quadrant, relieved by alkali. Roentgenologic study suggested a malignant tumor involving the antrum. Gastroscopy suggested hypertrophic gastritis in the antrum with question of infiltrating malignancy. At exploratory laparotomy the stomach was found to be perfectly normal. Free acid was 10 units.

This patient was followed postoperatively for four years during which time she had no special upper abdominal complaints. She had two severe attacks of upper abdominal pain radiating to the back, chest and neck. Consultation with a noted cardiologist revealed rheumatic heart disease, myocardial reserve limited and faint spells associated with bradycardia, auricular fibrillation and hypertension.

Habitual pylorospasm associated with cardiac disease has been reported.<sup>1</sup>

CASE 3.—A man, age 57 years, complained of anorexia, nausea and retrosternal pressure of two to three years' duration, occurring one to two hours after meals, intermittently but steady, for two to three months. Previous roentgenologic study ten months before admission had been negative. The free acid was 39 units.

The roentgenogram suggested a defect in the prepyloric area or base of the cap. On therapeutic trial he was comfortable despite the fact that he continued smoking against advice. Hospitalization for treatment was advised.

A repeat roentgen study four months after ulcer management in the hospital showed persistent antral deformity, with a normal duodenal cap.

Comparison of these latter films with the previous set forced a decision that the patient should reenter the hospital for exploratory laparotomy. The preoperative diagnosis was questionable carcinoma of the stomach or adhesions from a healed ulcer. Gastroscopy was negative.

Exploratory laparotomy revealed no significant changes in the stomach after thorough and careful examination from above and below in the lesser peritoneal space.

This patient was checked postoperatively, with roentgenologic investigation every six months to a year for eleven years. The prepyloric spasm was unchanged until death occurred from a cerebral hemorrhage.

CASE 4.—A man, aged 73 years, complained of pain in the upper portion of the abdomen, distention and loss of 14 pounds in weight over a period of one month. Free acid was 33 units.

Roentgenologic investigation showed an annular constriction which was believed to be due to a carcinomatous lesion. Gastroscopy was not done.

At exploratory laparotomy the stomach and duodenum were normal. The patient died of cardiac cause nine months after exploratory laparotomy.

CASE 5.—A man, aged 63 years, complained of periodic upper abdominal distress. Roentgenograms at several check-up examinations demonstrated unchanging prepyloric spasm with pyloric ulcer.

Exploratory laparotomy revealed stippling and benign ulcer at the pylorus.

Postoperatively, the crater disappeared with ulcer management, but persistent prepyloric spasm was present for three years of follow-up, with roentgen study every six to twelve months.

CASE 6.—A man, aged 58 years, came to the clinic because of epigastric fullness and discomfort for one week. Roentgenograms revealed a contracted area in the pyloric region which failed to fill normally for  $\frac{1}{2}$  inch proximal to the sphincter. Free acid was 23 units after an Ewald meal and gastric analysis. Recheck roentgenograms taken one month later demonstrated that the last inch of antrum was somewhat rigid. On the greater curvature side there was an irregularity which was persistent in all the films. One week later exploratory laparotomy determined that the pylorus was soft, patent and there was no evidence of carcinoma. Eighteen months later a roentgenogram showed the defect to be unchanged from the first examination. The patient's course was followed for eight years. He finally succumbed to coronary occlusion.

CASE 7.—A man, aged 60 years, had the chief complaints of exhaustion and "anemia." He had had "stomach ulcer" with tarry stools five years ago. Physical examination was negative. Roentgenogram demonstrated that the prepyloric region failed to fill out during the fluoroscopic observation and the films showed a *narrowing at that point due to spasm or possibly to an organic defect*. Two recheck examinations while he was in the hospital suggested increasing deformity in the prepyloric area showing constant narrowing which must be considered due to malignancy of the stomach. Achlorhydria was present. Gastroscopy was unsuccessful. At exploratory laparotomy there was contraction of the pyloric ring but no tumor or lesion was present. The patient's course was followed for three years and six months; he finally died of coronary thrombosis.

Four other patients did not have an exploratory operation, but gastroscopy was carried out in an attempt to rule out malignant disease. Roentgenograms taken six months, nine months, thirty-three months and thirty-seven months after the initial examination established the fact that these patients had habitual prepyloric spasm.

#### COMMENT

Case 1 may very well have been an instance of slow malignant growth as suggested by the gastroscopic report in spite of the first negative exploratory laparotomy.

It is often difficult to determine the absence of malignant disease in patients who show persistent prepyloric or antral spasm resistant to medical measures. The patient may have to be urged to have explora-

tory laparotomy, with the forewarning of the possibility of and the good fortune of negative findings, to decide the problem.

### CONCLUSIONS

Eleven instances have been reported of habitual prepyloric spasm. In seven instances exploratory laparotomy was done because the problem could not be safely decided without this procedure. Even with exploration, there is a possibility that malignancy was overlooked in 1 patient three years and five months before subsequent resection.

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## DYSPEPSIA AND SEROUS CYSTS OF THE KIDNEY

EARL E. EWERT AND LLOYD D. FLINT

SOME years back an analysis of 22 patients having serous cysts of the kidney was reported by the senior author.<sup>1</sup> By the addition herewith of 32 cases since 1939, the total number of patients seen at the clinic with this condition to date becomes 54. Because of the subject matter of this volume it will especially be shown that although the clinical symptomatology may be vague, abdominal pain and digestive tract disturbances occur often enough to confuse the gastroenterologist until complete urologic investigation discloses the source of the illness.

The average age for the total series was 52 years. There were 34 men and 20 women. The right kidney was involved in 25 cases and the left in 29. The more frequent finding of cysts in men was probably due to the almost routine use of pyelographic investigation in cases of prostatism.

Since this condition is usually found in the age group when most upper abdominal diseases are found, it must be considered as one other form of urologic disease that causes digestive disturbances. If located in the right kidney, the cyst may simulate disease of the bile passages. The case of one patient in whom a solitary cyst of the anterior surface of the right kidney produced extrinsic pressure distortion of the duodenum will be presented in detail. Renal cysts are by no means as rare a condition as previously supposed. Although Simkow collected but 315 cases up to 1932, only 33 of which were diagnosed preoperatively, subsequent authors<sup>1,2</sup> have reported increasing numbers of cases with the more extensive use of pyelography. The fact that the diagnosis is often overlooked is brought out by Bransch's finding of large renal cysts in 3 to 5 per cent of routine autopsies.

Although the controversial theories of the etiology of "solitary" renal cysts will not be gone into here, suffice it to say that Hepler's experimental production of serous cysts in rabbits by ligation of the arterial supply to a region where tubular block had been produced by fulguration is the most convincing evidence for the theory that such cysts are acquired in contradistinction to the congenital etiology of polycystic disease. It is especially convincing when one realizes that these cysts occur at an age when experimental factors are reproduced: ischemia from arteriosclerotic changes and tubular block from inflammatory fibrosis.

The location of the cysts in the complete series of 54 cases is given in Table 1. It will be seen that the lower pole is by far the most frequent site. To interpret the classification it should be stated that the pyelogenic cyst has a deeper origin than the simple cyst and, unlike the latter, communicates with some portion of the renal pelvis by a minute



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channel or duct and may originate as the result of a calculus. The parapelvic cyst is one which lies outside the kidney and communicates with the pelvis but does not represent a dilatation of the pelvis such as a hydronephrotic sacculation. Two of the simple cysts in the current series were multilocular in character.

TABLE 1  
LOCATION OF CYSTS  
(Total Series)

Midportion . . . . .	2
Upper pole . . . . .	2
Lower pole . . . . .	23
Anterior surface of kidney . . . . .	3
Intrarenal . . . . .	3
Multiple cysts (difficult to locate)	6
Pyelogenic . . . . .	1
Parapelvic . . . . .	1
Indefinite . . . . .	2

An analysis of the symptomatology of the present series of 32 cases is presented in Table 2. Nineteen patients had gastrointestinal symptoms. These were the chief complaints in 11. Radiographic investi-

TABLE 2  
SYMPTOMATOLOGY  
(Current Series—32 Cases)

No symptoms in any way referable to cyst	9
Abdominal pain or pressure . . . . .	11
Anorexia, nausea or vomiting . . . . .	7
Flatulence or heartburn . . . . .	7
Bowel disturbance . . . . .	5
Flank pain . . . . .	5
Dysuria (in uncomplicated cases) . . . . .	3
Hematuria, <i>microscopic</i> (with no other lesion)	3*
Palpable mass . . . . .	3†

\* 1 of these had gross hematuria

† Only 2 noticed by patient; found by physician in 6

gation of the gastrointestinal tract was carried out in 15 patients, revealing pathologic change in 5 (diaphragmatic hernia 2, irritable colon 2 and old duodenal ulcer 1). Interestingly enough, after excision of the renal cyst, the gastrointestinal complaints disappeared in all of these except one case of hiatus hernia, and this patient was an alcoholic. Abdominal pain, although apparently the predominant symptom, is in no way characteristic. The location is variable, sometimes in the upper quadrants, sometimes in the lower and sometimes paraumbilical. Its character is also vague and it may be a mere dragging sensation. Acute abdominal crisis such as in renal or gall-stone colic is not seen with an uncomplicated cyst. The accompanying dyspepsia also fails

to fall into a definite pattern. In all 5 cases with bowel disturbance, the cyst was located in the left kidney. This may not be statistically significant but Sinkoe reported such a case in which a large cyst of the lower pole of the left kidney exhibited extrinsic narrowing of the colon by barium enema and in whom the presenting symptom was obstinate constipation along with slight left inguinal pain. Quinby and Bright call attention to further peculiarities in symptomatology when the cyst is located at the upper pole of the right kidney. Here the cyst is between the kidney and under surface of the liver and produces localized pain in the right upper quadrant in over half the cases and pain in the right back in one fourth. Its position leads to difficulty in palpation and in two-thirds of the cases, physical examination is negative.

In our present series of 32 cases, only 8 had palpable masses and all these were cysts of the lower pole. Of the 19 with gastrointestinal symptoms, only 4 had palpable masses. Moreover, 2 patients with palpable masses had no symptoms.

It will be noted from Table 2 that there was a paucity of symptoms directly referable to the genitourinary tract. This is more strikingly brought out in considering the flank pain. In 2 cases the pain was in the side opposite to that containing the cyst. In 1 of these, the pain was due to stone in the opposite kidney. In 2 other cases, the flank pain was caused by stones in the cystic kidney with associated hydronephrosis in 1. Dysuria, also, means a complicated kidney or disease elsewhere in the genitourinary tract (most often prostatism in our cases). In 11 cases of microscopic hematuria, 4 were caused by other genitourinary disease and another 4 could presumably have been caused by hypertension. In regard to the latter, it is interesting to note that the average blood pressure for the men was 138 mm. systolic and 87 mm. diastolic and for the women, 167 mm. systolic and 101 mm. diastolic. In Braasch and Hendrick's 163 cases, only 3 had hypertension and it was noted that in none of these was the hypertension relieved by excision of the cyst. So far as symptomatology and clinical findings in the genitourinary tract are concerned, therefore, the cyst is always overshadowed by the presence of complicating or associated pathologic change. Accompanying pathologic change in the cystic kidney was present in 12 of our current cases (Table 3).

TABLE 3  
ASSOCIATED PATHOLOGIC CHANGES IN KIDNEY  
(12 of 32 Cases)

Chronic pyelonephritis	1
Hydronephrosis	2
Calculus (nonopaque)	2
Calcification, cyst wall	2
Multiple retention cysts	2

Finally the 9 patients who had no symptoms in any way connected with the presence of the cyst should not be overlooked. These cases

were picked up on routine pyelograms for prostatism (3), hypertension (3), stone in the opposite kidney, chance finding of cyst calcification in lumbosacral series and other unrelated reasons.

Reviewing the symptomatology, it is seen that since gastrointestinal symptoms predominate with or without palpable mass and the urine is not *diagnostic*, consideration must be given this clinical entity in the evaluation of upper abdominal diseases. It is thought that the initial



Fig 214.—a, Serous cyst, lower pole, right kidney apparent in plain kidney-ureter-bladder film.

b, Slight distortion of inferior surface of right pyelogram by the cyst.

scout film which precedes the usual gastrointestinal investigation should be taken with particular care as to technic to visualize soft kidney tissues at all times and not with the idea to rule out kidney stone alone. An abnormally low position of the kidney discovered this way should necessitate an excretion urogram to disclose, perhaps, a large cyst of the upper pole of the kidney as the unyielding structures above a cyst in this position might force the kidney downward. An example of the visualization of a renal cyst by a plain film of the abdomen is demonstrated in Figure 211, a. This 57-year-old woman had had cholecystotomy with drainage elsewhere eight years previously at which time, presumably, no renal cyst was apparent. The presenting symptoms were anorexia, anxiety and exhaustion. The gastrointestinal film (Fig. 215) disclosed a soft tissue mass displacing the hepatic flexure downward.

The diagnosis of serous cyst of the kidney is based on excretion or retrograde pyelography. In only 6 of the 32 cases was the cyst unsuspected from pyelograms, but in 5 of these, the preoperative diagnosis

was tumor which is more frequently than not indistinguishable from cyst roentgenographically. In the remaining case a correct diagnosis of nonopaque stone had been made in a patient with gout in whom the cyst was an incidental finding. The typical pyelogram (Fig. 214, *b*) reveals compression of the calical system with elongation of the calices so that they appear to be attempting to encircle the cyst in more or less of a ball and claw arrangement (the latter is not too obvious on this



Fig. 215 — Depression of hepatic flexure by serous cyst of right kidney.

film). There may be no distortion of the pyelogram and displacement of the kidney may vary from none at all to very marked relocation. The cyst itself may cause compression of the ureter or pelvis or both, producing hydronephrosis, or calcification may be seen. Yet with all these findings, no one can be sure that the above-described pathologic change is not a solid malignant tumor of the kidney. These patients must be considered just as much candidates for operation as if a diagnosis of renal cell carcinoma were made. Most urologists would not be content to make a diagnosis of renal cyst in a patient reasonably suited for surgery without carrying out a surgical procedure because every pyelographic pattern produced by this benign condition can be reproduced by a malignant tumor. The absence of urologic symptoms speaks neither for a solitary cyst of the kidney nor for a renal tumor of the most serious nature. During the corresponding period that the 32 cases of renal cyst were found at the Lahey Clinic, 47 patients with malignant



disease of the kidney were operated on, so that the relative incidences are fairly comparable. Benign solid tumors of the kidney are very infrequent and, as in other surgical conditions, the rule of surgical exposure holds true here also.

*Extrarenal conditions that occasionally may confuse diagnosis are retroperitoneal cysts, notably those involving the wolffian body, cysts of the mesentery, omentum, adrenal, pancreas, spleen and rarely, the ovary.<sup>4</sup> Sweet's description of 3 cases of splenic cyst demonstrated, again, vague subjective symptoms and a large tumor extending beneath the left costal margin which was pushed outward (this not occurring with pancreatic cysts). Pyelograms revealed the left kidney pushed downward but the pelvic contour unaltered. Sweet pointed out that in the flat plate, if the cyst is in the upper pole of the spleen (as all his were), the lower pole of the shadow is angular and pointed, extending into the right pelvis. In Jameson and Smith's case of calcified splenic cyst, the pyelogram showed the cyst to be separate from the kidney. Splenic cysts, however, are rare, 148 cases having been reported up to 1911.<sup>5</sup> Likewise, pancreatic cysts are rare, the incidence at the Mayo Clinic being 1 in 8000 admissions.<sup>6</sup> They occur more frequently in the tail and diagnosis is made by a roentgenogram of the barium-filled stomach showing smoothly rounded indentation of the greater curvature and anterior displacement. The kidney, again, may be exonerated by pyelography.<sup>6</sup> A more unusual case of cyst of the head of the pancreas has been reported<sup>7</sup> in which the right kidney was displaced to the left of the midline with rotation by a large tumor shadow in the right upper quadrant, the calices also being directed to the left of the midline. When differential diagnosis of renal cysts becomes a problem, the urologist usually has a sufficient diagnostic armamentarium to suspect, if not to establish, the diagnosis preoperatively.*

The treatment is excision. A lumbar exposure is performed and in most instances the cyst can be excised without delivery of the kidney. In the cysts of the lower pole very little of the kidney is even freed from its perirenal fat. The cyst, itself, is excised to the edges of the parenchyma and hemostasis effected by a coagulating current. The base of the cyst is cauterized with phenol and alcohol and a small Penrose drain is placed in the cavity. This was first advised by Herbst and others, and we have found no reason to change this procedure. Formerly, the earliest cases were handled by complete excision with control of bleeding by mattress sutures. This is unnecessarily thorough and destroys normal renal tissue. Also, the minor calices may be opened and, along with the sloughing of renal tissue by the compression mattress sutures, drainage can be prolonged. Simple excision and cauterization preserve all renal tissue present and eliminate lengthy convalescences. These patients may be allowed out of bed as quickly as their recovery from anesthesia will permit. These factors alone would seem sufficient to demand surgical intervention.

By excision of the cyst, all patients but 2 who had had symptoms were relieved of their complaints. One of these had an anxiety neurosis and the other was an alcoholic with an hiatus hernia.

### REPORT OF CASE

The following case is presented because the symptoms and findings pointed strongly toward the gastrointestinal tract as the site of pathology.

A 52-year-old weaver came in complaining of "stomach trouble" for ten years but more pronounced in the previous three months. He had periodic, nonradiating, para-umbilical pain more often before than after meals, with occasional relief when food was taken. There was flatulence and nausea without vomiting and intolerance to greasy foods. There were no urinary symptoms. He had been under medical care for a little over two years.

Physical examination revealed no weight loss, and was essentially negative with no abdominal masses or tenderness. The blood pressure was 130 mm. systolic and 80 mm. diastolic. Hematology and urinalysis were both normal with no urinary sediment. The gastrointestinal roentgenograms the patient brought with him showed the second portion of the duodenum to have increased mucosal markings, suggestive narrowing and marked deformity from extrinsic pressure. He also brought with him retrograde pyelograms taken elsewhere, revealing a solitary right renal cyst apparently on the anterior surface overlying the hilum. The typical circular displacement of the calical system was present accompanied by hilar compression without ureteral displacement (unfortunately these films are not available). Renal exposure was performed through a lumbar incision revealing a solitary cyst, approximately 10 cm. in diameter, on the anterior surface at the level of the hilum over which the ureter ran. Excision of the redundant portion of the cyst with carbolization of the base was carried out. Six months later the patient declared all his symptoms were definitely improved and the pyelograms were normal.

### SUMMARY AND CONCLUSIONS

Thirty-two additional patients with serous cysts of the kidney have been seen at the Lahey Clinic since 1939. An analysis of these cases reveals that the symptoms of this condition may simulate those of upper abdominal diseases, particularly because it occurs at a time when the largest number of cases of upper abdominal disease is found.

A routine scout film, unless carefully done, reveals only obvious renal disease, such as stone, and in an attempt to find the cause of dyspepsia, whether of gastric or cholic origin, an excretion urogram may give sufficient information to lead to a diagnosis.

A symptom-syndrome as such plus specific urine findings does not exist for renal serous cysts. Symptoms rarely point to the urinary system except in a complicated kidney or associated pathologic change of the urinary tract.

Treatment is surgical exposure (to eliminate renal malignancy) and excision of the projecting cyst wall, painting the lining membrane attached to the kidney with phenol and alcohol.

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## RECTAL BLEEDING

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A LARGE number of patients come to the clinic each year primarily because of rectal bleeding. They are aware of the possible significance of rectal bleeding and wish to be assured that they do not have a malignancy. Many additional patients examined at the clinic because of other complaints are found to have had rectal bleeding when questioned concerning the details of their illness.

It is not uncommon to find that patients who give a history of several months of rectal bleeding have an extensive malignant lesion of the rectum palpable to the examining finger. They have been lulled into a false sense of security by one or more barium enema radiographs of the colon, digital and proctoscopic examinations not having been done. Patients are not infrequently seen with advanced cancer of the colon and rectum who have undergone a hemorrhoidectomy or an excision of an anal fissure or papillae within recent weeks.

It is of the utmost importance, therefore, because of the number of patients who are primarily interested in the problem of rectal bleeding, the frequency of rectal bleeding in any large group of patients and the fact that an early malignant tumor may be overlooked by inadequate investigations, that the significance of rectal bleeding be appreciated by all physicians doing any type of general diagnostic work. It is of equal importance not only to determine the presence or absence of malignancy in every patient with rectal bleeding but also to discover and relieve the cause of such bleeding. It is possible after adequate examinations to assure a patient with occasional rectal bleeding that the bleeding arises from some other source than a malignant tumor. There can be no assurance, however, that cancer may not develop in the future.

Patients with rectal bleeding seen at the clinic are carefully investigated. Treatment which will stop the bleeding is then advised. In this presentation we will discuss the various types of rectal bleeding and their possible significance, the more common causes of rectal bleeding, the methods of investigation used at the clinic for their detection and some of the more practical methods of treatment.

A careful and detailed history of any patient with rectal bleeding will usually afford considerable aid in establishing the diagnosis. The character of the bleeding, the association of pus or mucus, the duration and amount, and associated symptoms must be carefully elicited from the patient.

### COMMON CAUSES OF RECTAL BLEEDING AND THEIR MANAGEMENT

The causes of rectal bleeding may be grouped according to those seen on inspection of the anal orifice and the perianal area, those

palpable to the examining finger, those visible with the proctoscope and sigmoidoscope and those detected only by radiographic study of the colon.

**Lesions Apparent on Inspection.**—The common causes of rectal bleeding which are apparent on inspection are anal pruritus, anal prolapse, prolapsing hemorrhoids and certain anal fissures, fistulas and ulcers.

The bleeding associated with anal pruritus is usually self evident. The excoriated perianal skin, thickened and frequently macerated, and the associated itching make the etiology apparent. Treatment is directed toward relieving the skin irritation, removing local infection and relieving the patient of his tension and anxiety.

Anal and rectal prolapse may be of varying degrees of severity. Frequently, localized areas of prolapse of the anal mucosa are encountered which may bleed easily on manipulation. The more extensive degrees of prolapse are obvious although straining on the part of the patient may be necessary to elicit the pathologic condition. Not infrequently following operative procedures such as the early Whitehead type of hemorrhoidectomy or the amputative types of operations, exposed areas of anal mucosa are seen which bleed with trauma. The bleeding in these conditions is usually bright red and spotty. These patients complain of blood on the toilet tissue and of soiling their clothes. No pus or mucus is associated.

The bleeding from an anal fissure or ulcer may be an occasional spot of bright red blood noted in the bowel or a blood-streaked stool. This bleeding is almost invariably associated with sharp shooting pain at the time of defecation. Inspection of the anal margin will usually reveal the presence of a fissure. The majority are found at the posterior commissure of the anal canal, although in women many are found at the anterior commissure. An overlying skin tab or "sentinel pile" is usually associated.

The bleeding from hemorrhoids is usually painless, frequently consists of spurts of bright red blood and may be large in amount. It must be remembered that the bleeding arising from hemorrhoids originates from the internal piles which cannot be seen without instrumentation. The presence of external hemorrhoids, however, suggests the probability of additional hemorrhoidal tissue in the anal canal. Fibrosed external skin tabs do not cause rectal bleeding.

Other less common causes of rectal bleeding may be apparent or suggested on inspection of this region. A stricture at the mucocutaneous junction following hemorrhoidectomy may be the cause of bleeding. Certain of the inflammatory diseases of the rectum may be suggested. Anal carcinoma is rare but occasionally is encountered. The ulceration and stricture occurring with tuberculous lymphogranuloma or venereal infections may be present.

The fact that a malignant lesion may accompany any one of the

aforementioned conditions, however, makes it imperative that the cause of rectal bleeding never be established by a cursory inspection of the perianal area and anal orifice. A digital and sigmoidoscopic examination and additional radiographic studies of the intestinal tract when indicated must be carried out on every patient with rectal bleeding before a final diagnosis is made.

**Lesions Palpable to the Examining Finger.**—A digital examination should follow an inspection of the anal orifice. The presence of a stricture, muscle spasm, operative scars, the induration at the base of a chronic anal ulcer or fissure, the tenderness of infected crypts, the induration of a fistulous tract, the soft, pulpy, painless enlargement of internal hemorrhoids, a tumor or polyp, the firm induration without ulceration, usually painless, of previous hemorrhoidal injections or the firm, indurated, ulcerated lesion of malignancy may be noted on palpation.

**Lesions Visible with the Anoscope, Proctoscope and Sigmoidoscope.**—Following digital examination of the anal canal and rectum, anoscopic and sigmoidoscopic investigations should be carried out. It is our policy when sigmoidoscopic examinations are performed to give a cleansing enema with a nonirritating solution, such as tap water or saline solution, before the examination. It must be remembered that for the ordinary observer adequate visualization of the anal canal is not obtained by the usual 10-inch sigmoidoscope. For this reason, in the majority of cases of rectal bleeding it is desirable to make use of both the anoscope for the inspection of the anal canal and the sigmoidoscope for the investigation of the rectum, rectosigmoid and low sigmoid regions.

Inspection of the anal canal through the anoscope will reveal the source in the largest number of cases of rectal bleeding. Hemorrhoids are the most common cause and their presence is obvious on inspection of this region. We believe that even though this bleeding is inconsequential so far as any disability or discomfort to the patient is concerned, treatment should be advised. It is our policy to inject internal hemorrhoids that are not too large and that are not associated with other local disease. For practical purposes, we have found that when a digital examination of the anal canal can be done without discomfort to the patient, when there is no evidence of stricture, fissure, fistulas, abscess, thrombi or other evidences of infection, internal hemorrhoids can adequately be controlled for an indefinite period of time with injections. A 5 per cent solution of phenol in almond oil has been employed at the clinic for hemorrhoidal injections for a number of years, with excellent results. Approximately 30 per cent of all patients with hemorrhoids are treated in this manner. There is a small number of patients who have recurrences and require subsequent injections, and a smaller group who eventually require surgical removal of their hemorrhoids.

*Following any local anorectal treatment the importance of establishing normal bowel function cannot be overemphasized. This is particularly true following either the injection or operative treatment of hemorrhoids. Many of these patients, because of the discomfort associated with their local anorectal disease, have developed irregular habits—the taking of laxatives or enemas and the use of suppositories and ointments. It has been our experience that an important part of the treatment of any of these conditions is the reestablishment of normal bowel function. That is particularly significant in the prevention of recurrences following the injection treatment of hemorrhoids. These patients are told that the injection of hemorrhoids does not entirely remove the hemorrhoids, but that it does shrink them, that they may recur, and that the reestablishment of normal bowel function lessens the possibility of their recurrence.*

Large, internal hemorrhoids, those with marked prolapse, when there are associated significant external hemorrhoids or other local pathologic condition, should be removed by surgical excision.

The next most common cause of rectal bleeding in the anal canal is that associated with the various types of fissure and ulcer. At the clinic we do not see many patients with small acute fissures of short duration because of the nature of our practice. Our experience with the nonoperative types of treatment, such as the injection of the base of fissures with preparations of the various anesthetics in oil, has been limited. Anal fissures that we encounter have been present for some time and are chronic in nature. They have not only an overlying external skin tag, that is, a "sentinel pile," but usually an hypertrophied papilla at the proximal end. Surgical excision is required for relief.

There are many other causes of rectal bleeding which may be visualized with the anoscope. The internal opening of an anal fistula may be seen. Bleeding from this source is usually associated with a purulent discharge and the history of an abscess. Infected crypts and irritated papillae may cause occasional bright red spotting. Usually irritating symptoms are associated and there is a discharge with this condition. The bleeding associated with the various types of inflammatory conditions may vary considerably in character. Occasional bright red spotting without other symptoms may be due to small patchy areas of localized nonspecific proctitis. The spotting present in patients with the more extensive chronic ulcerative proctitis and colitis will be associated with pus and mucus and varying degrees of diarrhea. Hypertrophied papillae or true anal polyps rarely bleed.

The stricture resulting from lymphogranuloma may be observed in both white and colored patients. The firm, indurated, glistening mucosa is usually diagnostic. Tuberculous strictures are found occasionally. Extensive stricture formation with multiple abscesses and fistulas may accompany chronic ulcerative colitis.

Above the anal canal the proctoscope or the 10-inch sigmoidoscope must be utilized to determine the source of rectal bleeding. The most common cause in this region is, of course, malignant disease. Mucosal polyps are the next best common source of bleeding and all such tumors should be considered as premalignant. Not only should every patient presenting the symptom of rectal bleeding be considered to have a possible rectal or colon malignancy until proven otherwise, but also any tumor, either palpated or visualized, should be considered as cancer until a final diagnosis is definitely established. To the experienced observer, many of these tumors can be accurately diagnosed on palpation. Inspection by instrumentation is probably of less importance than palpation or histologic study. A typical malignant tumor with the rolled edges and ulcer crater is diagnostic. Many of the various types of polyps cannot be differentiated without a careful histologic study. Lymphomas of the rectum, adenomas and lipomas are rare but have been encountered. All rectal tumors should be studied histologically before radical operative procedures are carried out.

One word of caution must be made in regard to many of these tumors. Benign polyps occur more frequently than has previously been recognized and are the most common rectal tumor. In a recent autopsy study we found benign polyps in the rectum and colon in 7 per cent of patients who died from all causes. We have also found that to rule out malignant degeneration in a rectal or colon polyp, since it has been shown that malignancy may develop in any portion, the histologic examination must be made not only of the polyp itself but of its pedicle and adjacent-bowel wall.

The various types of inflammatory processes found in the lower bowel will not be discussed in detail in this article. The typical punched-out bleeding ulcer of amebic dysentery is characteristic to the experienced observer. The multiple bleeding ulcerations, covered with pus and mucus, of ulcerative colitis are ordinarily not mistaken. A painless bright red bleeding in our experience has occasionally been due to a radiation proctitis. A history of radiation therapy for pelvic malignant disease, particularly of the cervix, gives a clue to this condition. Varying degrees of stricture are usually, but not always, associated.

Bleeding from above the sigmoid may be a massive hemorrhage owing to an intussusception, volvulus of the bowel, or it may be from the upper intestinal tract. The bleeding may be bright red or, more often, there may be a "tarry" stool. The more common type of bleeding from the colon, however, is small in amount, brown or black in color and mixed with the bowel content. The source of such bleeding frequently is difficult to determine. It may arise from a malignant tumor or polyp. Diverticulitis in a small percentage of patients may result in rectal bleeding. Ulcerative colitis may be segmental and, although usually visualized by the sigmoidoscope, it may be localized in any region of the colon above the rectosigmoid. Bleeding may be associated



with terminal ileitis. The bleeding from lesions in the right side of the colon, however, is usually not apparent to the patient and detected only by the presence of an anemia or a palpable tumor. The diagnosis is established by radiologic study.

**Lesions Detected Only by Radiographic Study of Colon.**—For diagnosis of lesions which cannot be visualized with the 10-inch instrument, reliance must be placed on radiographic studies.

It is not our policy to carry out a barium enema radiograph or a contrast air study of the colon in every case of rectal bleeding. It must be remembered that 70 per cent of the organic disease of the large bowel is visible with the 10-inch sigmoidoscope. Following inspection, anoscopic and sigmoidoscopic investigation, when the cause of rectal bleeding is apparent and there are no suggestions either from the history or the physical findings that disease above this point may exist, radiographic studies are not carried out routinely. So many of this group of patients, however, have symptoms of an alteration in bowel function, unexplained abdominal pain, an abdominal tumor, or an anemia associated with their rectal bleeding that radiographic studies of the colon are made in a high percentage of cases.

When roentgenologic studies of the large bowel are indicated to determine the presence of rectal bleeding, adequate preparation of the colon is essential. Preparation of these patients with a cathartic, 1 to 1½ ounces of castor oil by mouth the night before the examination, is desirable. No cathartic should be used in the presence of inflammatory conditions such as diverticulitis. A colonic irrigation is given the morning of the examination. The usual barium enema radiograph of the colon is then made. When the cause of the rectal bleeding is still not apparent following a barium enema, a contrast air study is also made. It is desirable that this investigation be made on a second examination with repetition of the preparation of the colon. *It is by this means that we have been able to discover many polyps in the colon which did not produce a defect in the lumen of the bowel and which were overlooked on the ordinary barium enema radiograph. The use of contrast air enemas, however, must not be overemphasized and it must be recognized that an occasional large malignant tumor easily detected by the ordinary barium enema can be overlooked if only the air technic is employed.*

There will, of course, be patients in whom laboratory and roentgenologic studies of the upper gastrointestinal tract will be made.

Gastric analysis, gastroscopy and roentgenologic studies of stomach, duodenum and small intestine may be required for the detection of rectal bleeding.

In our experience there has been a small group of patients in whom the diagnosis has been difficult. They have rectal bleeding, usually not associated with pain and frequently without other gastrointestinal or rectal symptoms. Complete investigations as already outlined have

been carried out without the source of bleeding being established. The problem comes up as to what one should do next. The common cause of rectal bleeding which is frequently overlooked is a small bleeding point in the anal canal. If one is accustomed, as we are, to doing sigmoidoscopic and even anoscopic examinations with the patient in the inverted position, it must be remembered that hemorrhoids tend to drain out and become collapsed in this position and can easily be overlooked. Thus, the first examination which should be repeated if such a situation exists is the anoscopic visualization of the anal canal. For accuracy, this should not be done with the patient in the inverted position but on his side or even at times in a lithotomy position with the patient straining. Many times a small bleeding point that has previously been overlooked can be observed with the patient in this position.

**Abdominal Exploration as a Means of Detecting Source of Bleeding.**—The question of abdominal exploration for the source of gastrointestinal bleeding is a serious one. We have occasionally resorted to this procedure. As our experience has increased, however, we have resorted less and less often to an abdominal exploration without having established a definite diagnosis. Roentgenograms for the detection of small polyps of the colon are notoriously unsatisfactory. We have found it necessary frequently to repeat the roentgenologic studies, both the barium enema and contrast air technics of the colon, several times before tumors have been detected. We believe that it is justifiable to carry out an abdominal exploration for the source of rectal or colon bleeding only after the most careful and repeated investigations.

\* \* \*

In summary, it may be said that although there is a wide variety of conditions, the majority of which are benign, which may cause rectal and colonic bleeding, this group of patients must be considered to have a serious organic lesion until proven otherwise. Careful inspection of the perianal area and anal orifice, anoscopic and sigmoidoscopic examinations and radiographic studies of the colon will reveal the source of such bleeding in almost all cases. When rectal bleeding is encountered, because the treatment usually is simple, its source should be removed.

If all patients are carefully studied at the first sign of rectal bleeding, the number of patients operated on with early and favorable/malignant lesions will be materially increased.

Rectal bleeding is never "insignificant."



## THE PRESENT STATUS OF THE LEMPERT FENESTRATION OPERATION

FRANK D. LATHROP

WHEN Toynbee, in 1841, demonstrated that fixation of the foot plate of the stapes within the oval window resulted in decreased hearing even though the neural mechanism itself might be intact, otologists everywhere directed their attention to a condition now known as otosclerosis. Clinically, otosclerosis is manifested in a patient by bilateral impairment in hearing associated with essentially normal ear drums and eustachian tubes in which the hearing by bone is characteristically better than by air. The latter aspect of this form of deafness has been the inspiration for numerous attempts to eliminate the barrier presented by an ankylosed stapes to the transmission of airborne sound to an intact organ of hearing by dietary, medical or surgical means in order that the deafness might be alleviated. Such efforts have resulted in almost universal failure until recent years.

Removal of the stapes was probably the first surgical procedure devised to improve the hearing in such cases. Kessel described this operation in 1876 and obtained fleeting improvement in hearing which was subsequently followed by total loss of hearing in the operated ear. This procedure was employed with similar success by numerous contemporary otologists and eventually abandoned until 1945, when Cawthorne modified the technic. The results in Cawthorne's series were variable and, on the whole, disappointing, but he implied that a satisfactory solution to the problem may yet be obtained through this approach.

Bárány, in 1911, was the first to attack the semicircular canals surgically in an effort to improve hearing. He reasoned that decompression of the vestibular portion of the labyrinth might permit increased movement of the footplate of the stapes in the oval window and thus allow improvement in hearing. For this purpose he created an opening in the posterior semicircular canal but met with indifferent success due, it was believed, to closure of the fistula by fibrous tissue or regenerated bone.

Holmgren, in 1917, likewise believing that decompression of the labyrinth was essential for improved hearing in otosclerosis, made an opening on the superior surface of the superior semicircular canal in order that it might be covered by the dura of the middle cranial fossa in an effort to maintain its patency. He subsequently abandoned this procedure, however, as being without value and turned his attention to the horizontal semicircular canal. Holmgren employed a variety of materials—Thiersch grafts, fat grafts, mucous membrane flaps and gold leaf—to cover the fistula he created in the horizontal canal in an attempt to maintain its patency. He met with some success and a few

of his patients obtained an *improvement in hearing*. These were insufficient, however, in number and in duration of improved hearing to permit the operation to be considered of value.

Sourdille, stimulated by the work of Bárány and Holmgren, became interested in *fenestration surgical procedures* in 1921. His conception of the problem differed in one important respect from that of his predecessors. Whereas Bárány and Holmgren stressed decompression of the labyrinth, Sourdille reasoned that the answer lay in making and maintaining an opening in the labyrinth in such a manner that it simulated the function of the oval window. To achieve this goal, he devised a multiple stage operation designed to obtain a thin cicatricial flap contiguous with the tympanic membrane with which to cover an opening, approximately 1 by 3 mm., made in the horizontal canal. Sourdille, in 1937, reported that an improvement in hearing was obtained in 80 per cent of the patients he operated on in this way. Sourdille's operation left much to be desired from a practical point of view chiefly because it necessitated three or more operations over a period of four or five months.

Lempert reported an operation for clinical otosclerosis in 1938, which was the forerunner of the fenestration operation performed at the present time. This operation was similar in principle to that of Sourdille's, but differed in two important respects. First, it was a one-stage operation and, second, the flap utilized to cover the fenestra in the horizontal semicircular canal was created from the skin of the osseous portion of the external auditory canal in such a manner that it remained continuous with the tympanic membrane. The formation of this plastic flap was facilitated by the employment of what he termed an "endaural" approach to the temporal bone. This was accomplished by incisions placed in the membranous segment of the external auditory canal in such a manner that, on their retraction, adequate exposure of the mastoid process and the osseous portion of the external auditory canal was obtained.

The relatively high incidence of failure to obtain lasting improvement in hearing with this operation stimulated Lempert to strive for a better answer to the problem. With the memory of his failures in mind, he attempted to improve his results by modifying the technical details of the operation, polishing the edges of the fistula with various metals and employing prosthetic devices in an effort to maintain the patency of the fenestra in the horizontal semicircular canal. As a result of this experimentation he finally reported, in 1941, a modification of his original operation which he designated as the fenestra nov-ovalis and which remains at this time the method of choice for the surgical treatment of otosclerosis. In this latter operation the location of the labyrinthine fistula has been moved forward so that it lies over the dome of the vestibule. In this situation the fenestra lies in close approximation to the oval window and is easily covered by the plastic flap obtained from the skin of the external auditory canal and contiguous

tympanic membrane. An air chamber is thus created from the middle ear which permits airborne sound to be transmitted directly to the perilyabyrinthine fluid and stimulate the neural mechanism of the organ of hearing. In this way the barrier presented by the ankylosed stapes within the oval window is by-passed and an improvement in hearing obtained in selected cases of clinical otosclerosis. Various technical minutiae have been added by other workers in this field but whether these will materially enhance the opportunity for success has yet to be decisively proven.

The Lempert fenestra nov-ovalis operation has revolutionized the surgical treatment of clinical otosclerosis. Since it was first reported in 1941, several thousand patients have been subjected to this operative procedure by numerous otologists located throughout the world. It is now possible, therefore, by reference to the reported results obtained by various operators, to gain some idea as to its feasibility.

The reported percentage of successes has varied to some extent but the fact has been established that the fenestration operation has proved of definite value in the rehabilitation of carefully selected patients exhibiting clinical otosclerosis. Lempert reported that about 75 per cent of the patients in his series have maintained an improvement in hearing to a practical and serviceable level for more than two years and presented the audiogram of a patient whose improvement had been maintained for approximately ten years. Shambaugh stated that 88 per cent of his patients have maintained an improvement in hearing of 10 decibels or more for two years or longer. The high percentage of successful results obtained in these two series clearly demonstrates the feasibility of the present fenestration operation when performed by a competent otologist properly trained and experienced in fenestration surgical procedures.

Nevertheless, the fenestration operation still leaves much to be desired. It is not possible at this time to inform a patient with clinical otosclerosis that his hearing will be improved by operation even though he may more than fulfill the established prerequisites for such surgery. Furthermore, it is not possible to predict the degree of improved hearing that may be realized or how long the improvement will last. The explanation for our inability to prognosticate satisfactorily with respect to these points lies in the inadequacy of present day hearing tests and the incapacity to prevent closure of the fistula by bone regeneration in every instance. Until such a time as a practical method has been devised to determine accurately the amount of potential cochlear function present in an ear and a surgical technic has been evolved that will ensure the permanent patency of the fistula in every case, there will always be a certain percentage of failures.

A great deal has been written with respect to the beneficial results that may be obtained with this surgical procedure, very little with respect to a careful analysis of the failures that have indubitably occurred, and none at all, to my knowledge, with respect to the possible

psychologic effect the result obtained may have upon the patient. When success is the eventuality any psychologic change is for the better. Should fenestration surgery result in failure its psychologic effect upon the patient may be cause for concern. The psychologic make-up of many patients afflicted with otosclerosis is such that they are poorly prepared to withstand with equanimity the psychologic impact of failure to obtain an anticipated improvement in hearing.

This latter point should receive consideration. Increasing numbers of patients are being subjected to the fenestration operation by an ever increasing number of "fenestration specialists." Under such circumstances a greater number of unsuccessful results necessarily must occur with a proportionate increase in the number of "psychologic cripples." The answer to this aspect of the surgical treatment of clinical otosclerosis lies in the selection of the patient to be subjected to such a surgical procedure and the training of the surgeon who is to perform the operation. These two factors are inseparable when considering the possible end result that may be obtained in an individual case.

Strict adherence to the criteria for the fenestration operation established by Lempert, moderated by clinical experience and common sense, will eliminate all but a few of those patients who are not suited for operation. In addition, in order that the number of failures may still further be reduced it is necessary that the surgeon be adequately trained. It should be remembered that this is a major surgical procedure requiring a high degree of technical skill and that the training of the surgeon should, first of all, embrace a considerable background of diagnostic and surgical experience in the general field of otology and, second, specialized training in fenestration surgical procedures.

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## METASTATIC BRAIN TUMORS

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In any neurosurgical clinic the problem of management of metastatic intracranial lesions will be repeatedly encountered. The ultimate prognosis for these cases is, of course, hopeless. The immediate result in terms of useful survival is so often disappointing that the neurosurgeon accepts these cases with considerable reluctance. Yet in spite of the marked pessimism with which this group of intracranial tumors is regarded, there are occasional striking exceptions—patients who have had gratifying and worthwhile survivals following craniotomy for verified metastatic lesions. If criteria were available for identifying the cases in which useful survival is probable, the management of this problem would be less difficult.

### INCIDENCE

The relative incidence of intracranial metastatic tumor will vary with the type of hospital service from which material is studied. The incidence in a neurosurgical clinic will be relatively low (4.2 per cent in the Cushing series<sup>3,6,7</sup>; 4.1 per cent in the present study). The neurosurgeon sees only a selected group of patients with intracranial metastases since many cases are never presented for surgical consideration. Actually, metastatic lesions have represented 13.5 per cent,<sup>8</sup> 17 per cent,<sup>2</sup> and 17.9 per cent<sup>1</sup> of all intracranial tumors in autopsy series from general hospitals.

### PRIMARY SITES

The commonest primary source of intracranial metastasis is the lung. In a series studied by Globus, 55 per cent of all intracranial metastases were secondary to lung tumor. Other primary sources are the breast, gastrointestinal tract, kidney, thyroid, prostate, and so forth. The common pathway for metastasis to reach the cranial cavity is from the lung via the blood stream, and either primary or secondary pulmonary lesions will be found in at least 80 per cent of cases that come to autopsy with metastatic intracranial tumor.<sup>3,8</sup>

The importance of preoperative roentgenologic examination of the chest is thus quite apparent. In spite of the fact that the lung is so frequently involved, however, demonstration of the pulmonary lesion may be difficult or impossible. In a group of cases with verified pulmonary lesions 35 per cent were reported as negative from roentgenologic study.<sup>4</sup>

### CORRELATION OF CLINICAL FACTORS WITH DURATION OF SURVIVAL

We have reviewed the experience of the neurosurgical department of the Lahey Clinic in dealing with surgically verified metastatic



brain tumors during the period from 1934 through 1945. We have been interested particularly to find criteria that might aid in identifying those cases in which useful survival is probable. During this period 1256 brain tumors have been surgically verified and of these 51 proved to be metastatic, an incidence of 4.1 per cent.

This series of surgically verified metastatic brain tumors has been separated into three major groups for study:

Group A: *Patients with no signs or symptoms suggesting metastatic malignancy.*

This will include patients in whom the differentiation from primary brain tumor can be made only at operation.

Group B: *Patients with previously known malignant lesions.*

Many of these patients will have had remote surgical treatment for their primary lesion.

Group C: *Patients with general debilitation suggestive of systemic malignant disease.*

Significant weight loss was the common clinical finding in this group.

In classifying survivals we have considered that all patients who failed to survive longer than one month following operation have "zero" survival. Thirty-six per cent of the patients in this series failed to survive longer than one month following craniotomy. Survival of less than six months is classified as not significant for the purposes of this study, although in particular instances survival of three, four, or five months may be very worth while. Of the entire series 30 per cent survived longer than six months, and approximately half of these (16 per cent) survived longer than two years.

Table I compares the survival of patients on the basis of the three major groupings described above. It is quite apparent that the patients in Group C showing evidence of systematic debilitation had uniformly poor survival. No patient in this group lived six months following operation. These poor results are not explained by mortality during the first postoperative month since survivals through this period are comparable for all three groups.

It is of interest that survivals in Group B proved higher than in Group A. Although both groups are small in number, the fact that patients with known primary malignant lesions had as satisfactory survival as patients with no clinical evidence to suggest malignant disease is of considerable significance. It is surprising to find that even in the presence of other demonstrable secondary lesions by roentgenologic examination of the chest, these patients all survived longer than six months and in one case longer than two years.

Reference to Table 2 helps to explain these unexpected survivals in the presence of known primary malignant lesions. This table compares

TABLE 1  
SURVIVALS

Clinical Classification	No. of Cases	Longer than 1 month	Longer than 6 months	Longer than 24 months
Group I. No clinical symptoms or signs of malignant disease.	22	13 (60%)	7 (31.8%)	4 (18%)
Neg. chest x-ray	4	2	1	0
Pos. chest x-ray	1	2	1	0
No chest x-ray	11	9	5	1
Group II: Known primary malignant lesion (remote).	12	8 (67%)	6 (50%)	3 (25%)
Neg. chest x-ray	8	4	2	2
Pos. chest x-ray	3	3	3	1
No chest x-ray	1	1	1	0
Group III: Debilitation suggesting systemic malignant disease.	10	7 (70%)	0 (0%)	0 (0%)
Neg. chest x-ray	3	2	0	0
Pos. chest x-ray	6	4	0	0
No chest x-ray	1	1	0	0
Totals	41*	28 (64%)	13 (30%)	7 (16%)

\* Follow-up data not available for 7 patients.

TABLE 2  
SURVIVALS

Duration of Intracranial Symptoms	No. of Cases	Longer than 1 month	Longer than 6 months	Longer than 24 months
6 weeks or less	15	11 (73%)	1 (6%)	0
3 months or more	23	16 (70%)	10 (43.5%)	6 (26%)

survivals in terms of the duration of intracranial symptoms prior to surgery. Of the 15 cases with symptoms of six weeks' duration or less, only one patient was alive six months following craniotomy. Of the 23 cases with symptoms of three months' duration or longer, 10 were alive after six months, and 6 of these lived longer than two years. Again, the difference between these groups is not explained by higher mortality in the first postoperative month since survivals to that point are almost identical.

It is of interest that the presence of either primary or other secondary malignant lesions was established in 57.7 per cent of the patients in

this series prior to surgery. In 4 additional patients a metastatic intracranial lesion was strongly suspected because of marked general debilitation, although the primary or other *secondary lesions* could not be identified preoperatively. Thus in approximately two-thirds of this series there was strong evidence that the intracranial symptoms were due to metastatic tumor. In approximately one-third there was no objective clinical evidence or symptomatology to suggest a metastatic lesion, although not all patients in this latter group were screened by chest roentgenologic examination. Routine roentgenologic study of the chest would undoubtedly have added to the group in which metastatic tumor could be considered clinically established.

The site of the primary tumor in the cases in which it could be definitely established was not unusual, except that the relative number of lesions primary in the lung was less than would be anticipated from other studies.<sup>4</sup> Survival in relation to site of primary lesion is tabulated for 30 cases in Table 3. In this small group, patients with metastasis

TABLE 3  
SURVIVALS

Site of Primary Malignancy	Number of Cases	Longer than 1 month	Longer than 6 months	Longer than 24 months
Kidney	5	4 (80%)	4 (80%)	3 (60%)
Breast	9	7 (78%)	3 (33%)	2 (22%)
Gastrointestinal tract	7	4 (55%)	2 (28%)	2 (28%)
Lung	9	6 (67%)	0 ( 0%)	0 ( 0%)
Total	30	21 (70%)	9 (30%)	7 (23%)

from primary renal tumor had relatively much longer survival than any other group. From these data it is suggested that, of the four primary sites studied, the kidney is relatively most favorable and the lung relatively least favorable for significant survival.

Of the 37 cases in which the metastatic tumor was apparently solitary and its location could be accurately defined, 73 per cent were above the tentorium, and of the supratentorial lesions, two-thirds were in the left hemisphere. This suggests that the left carotid circulation is the more frequent route for metastatic seeding to the brain.

In the series of metastatic intracranial tumors studied by Globus and Meltzer,<sup>5</sup> only 10 per cent had significant papilledema. In contrast, in the present series 60 per cent of the patients had definite choked disks. In our experience survivals have been significantly longer in the group of patients without papilledema, as shown in Table 4 which summarizes survival from this standpoint.

On the basis of our experience three clinical factors will prove of considerable value in anticipating survival in cases of metastatic brain

TABLE 4  
SURVIVALS

Optic Disk	Longer than 1 month	Longer than 6 months	Longer than 2 years
"Choked"	17 (60%)	4 (14%)	2 (7%)
"Not choked"	16 (73%)	10 (45%)	5 (31%)

tumor. These are, in order of relative importance, the presence or absence of *general debilitation*; the *duration of intracranial symptoms*, and the presence or absence of papilledema. When these criteria are applied in segregating patients in whom significant survival is unlikely, it is found that no patient with general debilitation lived six months following operation, and that only one patient with intracranial symptoms of less than six weeks' duration was alive six months after operation. The ability to anticipate survival on the basis of the presence or absence of papilledema is less striking but significant, since patients without papilledema had three times as many significant survivals as the group with choking. When these criteria are applied in selecting patients in whom significant survival is probable, it is found that 10 patients satisfied all three factors—absence of debilitation, symptoms of three months' duration or longer, and absence of papilledema. Three of these patients died during the immediate postoperative period but the remaining 7 patients all lived longer than six months, and 5 of them lived longer than two years.

## SUMMARY

We have reviewed the experience of the neurosurgical department of the Lahey Clinic in dealing with surgically verified metastatic brain tumors.

We have found three clinical factors, the *presence or absence of general debilitation*, the *duration of intracranial symptoms* and the *presence or absence of papilledema* to have correlation with duration of survival in these patients.

The utilization of these factors in the evaluation and estimation of survival in patients with metastatic brain tumors may prove clinically useful.

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## **PREFRONTAL LOBOTOMY**

### **General Impressions Based on Results in 470 Patients Subjected to This Procedure**

**JAMES L. POPPEN, JOHN B. DYNES, AND PRESTON S. WEADON**

THERE is, perhaps, no disease which creates greater havoc in a patient and his immediate family than mental disturbances. Many types of insanity are not amenable to psychiatric measures, even though considerable strides have been made in recent years by the use of various forms of shock treatment as an adjuvant to psychiatric treatment. Moniz, in 1936, first reported the results in patients whom he had subjected to operations on the frontal lobes in an attempt to ameliorate mental disorders. The dramatic changes that took place stimulated Freeman and Watts to institute psychosurgery in this country. Under considerable criticism, both from psychiatrists and neurosurgeons, they continued their work and managed to convince others that surgery directed to the frontal lobes was of real value in many patients suffering from mental disorders. Other neurosurgeons were reluctant to carry out leukotomy since psychiatrists in many instances in their immediate community were strongly opposed to an operation that destroyed brain tissue and altered permanently the personality of the individual. Also, neurosurgeons hesitated to perform an operation which involved a technic that divided brain tissue blindly. Lysterly, in 1939, reported a technic which eliminated this objection. We have adopted his technic, with certain modifications. Freeman and Watts, however, have developed the blind technic to such a fine point that they are accurate to an uncanny degree.

Since 1943, 470 lobotomies have been performed by us. The majority were carried out at the Boston Psychopathic Hospital. It has been the opinion of one of us (J. L. P.) that the major role in the surgical treatment of mental disorders must be played by competent psychiatrists. Only a few, if any, neurosurgeons are properly equipped to decide as to the relative merits of conservative measures versus surgical treatment in an individual patient. The neurosurgeon does not have the time nor the training to study the patient's mental aberrations thoroughly before treatment is instituted. Since many patients are not cured by lobotomy they must necessarily have continued guidance by the psychiatrist. It is, therefore, the duty of the neurosurgeon to perform the operation as safely and as adequately as possible and, in a measure, act solely as a technician. In being a technician, however, he must not lose sight of the fact that the function of the frontal lobes must be clarified if at all possible. Since the operation allows one to carry out physiologic studies, it is necessary to make available perti-

nent data before operation, during operation and following operation. We have been particularly fortunate in having the majority of these patients carefully studied, not only from the psychiatric standpoint but also the physiologic and anatomical aspects, by Dr. Solomon and his associates at the Boston Psychopathic Hospital.

In general, the indications for psychosurgery are involuntal melancholias, agitated depressions, severe obsessive compulsive states, paranoid dementia praecox, catatonic dementia praecox, criminal psychopaths, kleptomaniacs, sexual perversions, these given in sequence roughly as to the good results obtained. Since lobotomy relieves tension, self concern, fear and depression, it is evident that the patient afflicted with any of the above conditions actually is tortured by self concern over his condition. It naturally would be difficult in a patient suffering from a catatonic dementia praecox to determine whether he is concerned over his condition or not, because of his mutism. However, any patient who has a major complaint by which he is tortured is at least in a position to obtain relief by lobotomy. Perverts, kleptomaniacs or criminals who are not concerned over their misdeeds probably will not be helped by this operation. The patient least likely to be helped is one who is apathetic toward his condition or has no major complaints. The breaking down of the mental disorders in a diagnostic category may not, therefore, be of great help in determining the suitability of the patient for operation.

Lobotomy is indicated in certain patients with intractable pain. Eighteen patients have had lobotomy for pain, with or without morphine addiction. These patients lose all fear of pain or death. It is well known that patients with inoperable malignancies feel that each newly developed pain or discomfort suggests that death is that much closer, and for that reason the pain and fear of death become intolerable. Following lobotomy, he is not concerned either about the pain or death. His anxiety and fear of impending death from cancer is dissipated, therefore making his remaining days more comfortable. Incontinence may occur more frequently following cordotomy than lobotomy. Much can be said for lobotomy in patients who have nothing to look forward to but pain and death. This type of surgery should not be instituted unless the entire situation has been discussed with the patient's immediate relatives. It is important that the patient's finances are in order since he will live in the immediate present following the operation and his foresight as well as his insight may be blunted. The legal responsibility of a patient following lobotomy has not been established, but it is our opinion that the patient and his family should be informed of the change that will occur in his personality so that proper safeguards might be instituted prior to operation. In none of the patients has it been necessary to resort to narcotics for pain following lobotomy even though it had been necessary to prescribe large doses of narcotics at frequent intervals before operation. It is conceivable that the life of

the patient subjected to lobotomy because of malignancy may be prolonged since in many instances narcotics rather than malignancy were the cause of the lack of appetite and loss of weight.

In order that opinions may be formed as to the results obtained by lobotomy, it is necessary to institute routine studies as well as specialized investigations before surgery is undertaken: a complete physical examination, laboratory studies including blood and urinalysis, glucose tolerance, electrocardiograms and electroencephalograms in selected cases, blood pressure studies, carotid sinus stimulation, spinal fluid studies and psychometric survey. These studies must be recorded before operation if an accurate comparison is to be made following leukotomy. Only in this manner can valid deductions be made as to the function of the frontal lobes.

The operation<sup>5</sup> is carried out under intravenous pentothal anesthesia. Two sagittal incisions are made in each frontal area and a 1 inch button of bone is removed through each incision by means of a specially built trephine.<sup>1</sup> The frontal lobes are then separated from the rest of the brain, with the exception of small portions of the cortex and the blood supply, under direct vision (Figs. 216 and 217). If, of course, the blood supply were interfered with during operation, brain tissue distal to the frontal lobes would be affected and, therefore, the function of the frontal lobes could not be as accurately studied. The buttons of bone are replaced and the scalp incisions are closed. The entire operation takes approximately one half hour.

The immediate postoperative course is usually smooth, the patient waking from the anesthesia well oriented and cooperative. It is necessary to keep the patient well oxygenated during his recovery from the anesthetic agent. On the second or third day the patient may be somewhat obtund and less oriented, no doubt due to cerebral edema from the operative interference. The body temperature may be elevated at times to a degree that infection is suspected. Chemotherapy may be instituted unnecessarily. The spinal fluid pressure may be considerably elevated for several days following operation with blood noted in the spinal fluid and an increase in the white cells. It is, perhaps, wise to lower the spinal fluid pressure periodically if this occurs.

Several stitch infections have occurred, necessitating removal of bone buttons in 7 patients. Five operative deaths have taken place in these 470 patients. Three patients died within two weeks following operation, one on the seventh postoperative day from convulsions caused by an unsuspected hemorrhage into the site of operation, and another ten days following operation from either pulmonary edema or aspiration. The autopsy revealed no intracranial cause for death. The third patient died two weeks following operation from cerebral edema and hemorrhage. This patient had a changed blood picture, the bleeding time being greatly increased. Two other deaths must be classified as a result of operation; one patient died four months after operation during a



convulsion and autopsy revealed a brain abscess in the site of the leukotomy.

Postoperative convulsion has been a hazard. Ten per cent of patients have had one convulsion or more following operation. Greenblatt, at the Boston Psychopathic Hospital, in performing electro-encephalo-

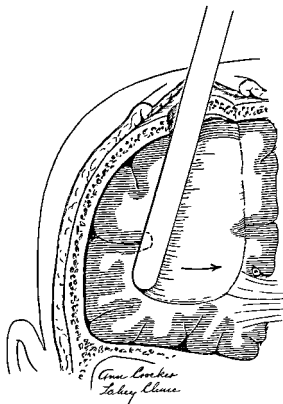


Fig. 216 —The coronal plane in which the white tissue is divided with a blunt spatula.

grams on 55 patients before and after operation, found that in the patients who did not develop seizures following operation, abnormal waves were demonstrated before operation in 20 per cent and after operation in 50 per cent, with the brain waves gradually returning to their preoperative levels. In patients who developed convulsions, 50 per cent had abnormal brain waves before operation and approximately 65 per cent after operation.

Twenty per cent of the dementia praecox patients obtained good results and were able to return to work and make a living. Thirty-seven

per cent had fair results, with remission of their symptoms, and were more easily managed. Forty per cent had poor results; their condition remained unchanged. Three per cent of this group died.

The results in the patients with involutional melancholias were quite favorable. Fifty-five per cent showed good results, 33 per cent fair results, and the remainder were unchanged.

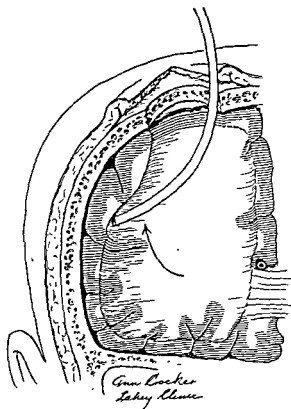


Fig. 217.—The extent of the division of brain tissue at the completion of operation is shown.

The results in the agitated depressions in the aged have proved to be gratifying in most instances. These patients tolerated the operation well, even though cerebrocardiovascular changes were advanced.

It is only fair to state that in the first two years only the patients with very severe disorders who had been institutionalized for many years, were subjected to operation. This accounts, of course, for many of the poor results in the dementia praecox group.

Several patients were subjected to leukotomy who had hypertensive

encephalotomy and diabetes with mental changes. This was done in an effort to alter the central contributing mechanism for both of these disorders. Early results seemed encouraging. The symptoms, however, returned to their preoperative levels within a few weeks or months.

### COMMENT

In our experience the duration of the disease or the age of the patient has not been as great a factor in the results obtained as the degree of tension, anxiety, fear and self concern that was present. In other words, psychosurgery is of no great value in patients who are not concerned about their problems. The patients, following operation, are complacent, self-satisfied, readily satisfied with their environment; they may be easily upset at interference with their wishes. The patient's intelligence, his capacity for adjustment and his initiative before operation, however, largely determine the amount of stimulation and prodding necessary for readjustment. The degree of improvement in initiative depends, therefore, on the amount of reeducation instituted. In order to obtain the maximal results, it is necessary for the patient's family to have sufficient interest and understanding to help in the process of readjustment, and for that reason psychiatric aid is usually of the greatest importance and value in the attempted rehabilitation of the patient following lobotomy.

It has been discouraging to find that a return of preoperative status of hypertension and diabetes has taken place following lobotomy in patients whose early results seemed promising. At the present time studies are being carried out by direct stimulation of small areas of the brain in the region of the leukotomy, including the anterior caudate nucleus, corpus callosum and hypothalamic area, during which time recordings of the blood pressure, pulse, respiration and blood studies are made. Certainly, it would seem that an operation that could be directed toward the central regulatory system would be the logical method of attacking the problems of hypertension and diabetes, if such conditions can be changed by surgery.

It is our opinion that lobotomy is a valuable adjuvant in the treatment of certain serious mental disturbances.

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## DE QUERVAIN'S DISEASE: STENOSING TENDOVAGINITIS OVER THE RADIAL STYLOID

G. EDMUND HAGGART AND EARL F. WINTER

IN the differential diagnosis of persistent wrist pain the possibility of de Quervain's disease or stenosing tendovaginitis over the radial styloid should be kept in mind. This is particularly true if the onset of symptoms is relatively gradual, in the absence of trauma and if the patient has occasion to use the hand excessively. Since the original article by de Quervain there have been repeated references in the literature<sup>2,5,7,8</sup> but in spite of this fact it would appear that knowledge of this condition is not widespread.

### ANATOMY AND PATHOLOGY

Stenosing tendovaginitis over the radial styloid is the result of marked hyperplasia and thickening of the sheath which envelops the tendons of the abductor pollicis longus and extensor pollicis brevis as they pass through a common tunnel in a bony groove over the radial styloid beneath the dorsal carpal ligament. Figure 218 illustrates the significant anatomy of this region. As pointed out by Philip C. Potter, it is quite possible that the primary pathologic change may well be limited to the dorsal ligament and that the variations from normal which are encountered in the sheath and tendons are secondary. It is likewise to be kept in mind that in the position of full abduction of the thumb these tendons exert a considerable pull on the distal end of the radial compartment and, furthermore, the direction of this pull is at right angles to the long axis thereof. Hence, the tendon sheath is squeezed between the dorsal surface of the tendons and the dorsal ligament. Furthermore, it is to be noted that the tendon of the abductor pollicis longus is inserted into the lateral aspect of the base of the first metacarpal while that of the extensor pollicis brevis is inserted into the dorsum of the base of the proximal phalanx of the thumb, so that the divergence of these tendons additionally tends to cause tension to be exerted on the sheath in the position of wrist extension and abduction of the thumb.

At operation, the tendon sheath is hyperplastic and often markedly thickened, thus constricting the underlying tendons and interfering with their normal gliding motion. Three of the patients operated on had definite granulation tissue covering the tendons and adhesions between the sheath and the tendons. In another patient there was obvious flattening and constriction of the tendon as it passed under the ligament.

*Roentgenograms* have been consistently negative save for one patient in whom there was a suggestion of some slight periosteal reaction over the lateral aspect of the styloid process directly underneath the tendons. In no instance was calcification observed adjacent to the bone.

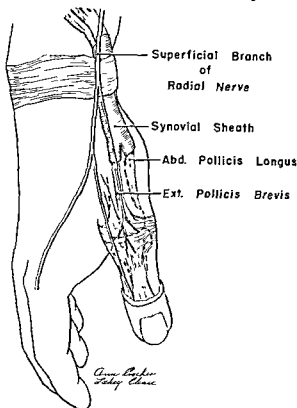


Fig 218—The tendons of the abductor longus and extensor brevis pollicis, covered by their synovial sheath, passing upward beneath the dorsal carpal ligament. It is this part of the ligament which is divided at operation. Note the cutaneous branch of the radial nerve which must be preserved.

#### CLINICAL COURSE AND EXAMINATION

All of the patients in this series were women, a fact which has previously been stressed by practically all writers on the subject.

In the majority of instances the symptoms were of gradual onset over a period of weeks or months without any known definite trauma. Without exception, all patients had been engaged in some manual occupation necessitating over-use of the extensor and abductor thumb

muscles. One individual had received a sharp blow over the region of the wrist two to three weeks before onset of symptoms which may have been a factor in causing the development of this condition. There is at first an aching discomfort, later becoming a pain, often very severe, localizing in the region of the radial styloid and, in some instances, extending into the hand and up the adjacent forearm. At an early stage the patient notices definite weakness of the thumb as well as pain associated with movement of the thumb.

On clinical examination there may or may not be a local swelling over the lateral aspect of the radial styloid but there is consistently localized tenderness in this region on firm pressure, especially in the distal portion of the compartment containing the tendons, which, as noted in the anatomical diagram, form the lower margin of the anatomical snuff box. A very satisfactory diagnostic sign, as indicated by Finkelstein, is that of having the patient place the thumb in the hollow of the palm, gripping it with the fingers, and with the hand in this position, force the hand into ulnar deviation, which motion causes exquisite pain referred to the region of the lower end of the radius. In a few of our patients, while no swelling was visible, palpation not only exhibited the tenderness described but also there was evidence of a firm, hard mass over the radial styloid.

An interesting variant of this condition is described by Zadek in which the stenosing tendovaginitis involves the tendon of the flexor pollicis longus and causes a fixed flexion deformity of the interphalangeal joint.

### TREATMENT

Conservative treatment in our hands has not been successful in relieving the symptoms. We were forced to carry it out in 2 patients before they in turn finally agreed to surgery. It comprises applying a plaster cast to the entire thumb and extending from the middle crease of the palm up to the mid forearm, holding the thumb in abduction and extension. This will relieve symptoms at the time but even when such treatment is carried on for many weeks, once the cast is removed the symptoms recur.

Consequently, it is our belief that surgery is far and away the most satisfactory and definitive therapy. It should be performed under a tourniquet and comprises a small longitudinal incision over the lateral aspect of the radial styloid, taking particular care to preserve the small cutaneous branch of the radial nerve (Fig. 218), which the bloodless field makes easily feasible. The carpal ligament and the tendon sheath are then incised. Because there was such marked local reaction, in all our cases a portion of the ligament was also removed as well as the hyperplastic synovial membrane surrounding the tendon. This procedure releases pressure on the tendons and thereafter allows them to glide freely in their groove. The wound is closed in the usual

manner, a small pressure dressing applied and in twenty-four hours the patient started on active motion of the thumb.

Without exception, the results have been most satisfactory and the 10 patients operated on have remained asymptomatic throughout a follow-up period ranging from eight years to twenty-three months.

In one patient who developed symptoms in the opposite wrist three years after rapid complete recovery from operation on the wrist originally involved, roentgen therapy was attempted. This is mentioned only to be condemned because in this individual at operation on the second wrist, there was marked scarring and fibrosis of the ligament and the tendon sheaths, making the surgical procedure considerably more difficult than was true of the wrist first operated on.

### SUMMARY

De Quervain's disease or stenosing tendovaginitis over the radial styloid should always be considered in the differential diagnosis of painful wrist. The diagnosis is not difficult if the possibility is kept in mind, particularly if there is marked pain on movement of the thumb with localized tenderness over the lateral aspect of the radial styloid. Frequently there is also evidence of induration. The onset usually is gradual and there may or may not be discernible swelling. Treatment is surgical, with incision of the dorsal carpal ligament and tendon sheath of the extensor pollicis brevis and abductor pollicis longus with or without excision of hyperplastic tissue, in turn to be followed by early active motion.

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## CHRONIC OSTEOMYELITIS

JAMES L. TOUMNEY AND FRANK L. SHIPP

DURING the war years the treatment of osteomyelitis was considerably advanced. The greatest contribution, obviously, has been the introduction and, in the latter part of the war, the wide use of penicillin. This has permitted primary closure to be done more successfully than with the sulfonamides which first permitted this improvement in technic.

The next most important contribution has been the use of small bone grafts in the obliteration of osteomyelitic cavities. Soft, cancellous iliac bone has proved ideal for this purpose. Before bone chips were used, cavities directly under these skin flaps often gave rise to sinus formation. The use of multiple bone chips has also permitted the more radical removal of infected bone, thus aiding in the prevention of pathologic fractures. While bone defects in sites well covered with muscle cause little difficulty in healing, large defects in exposed bone, for example, the subcutaneous surface of the tibia, frequently cause primary closure failures because of loss of substance beneath the skin flaps.

The war has also brought about a much wider use of skin grafting procedures in dealing with osteomyelitis. Split thickness grafts have been used both for permanent covering for exposed bone and also for temporary covering, to be later replaced by pedicle flaps. Split thickness grafts are used as well to cover defects made by relaxing incisions. Also, filling bone defects with muscle transplants is a valuable means of obliterating dead spaces.

The above methods of dealing with chronic osteomyelitis in long bones in which nonunion has occurred greatly hasten the clearing up of the infection so that reconstructive bone grafting can be employed at a much shorter interval after infection than ever before.

In spite of these great advances, chronic osteomyelitis remains a problem in both civilian and military practice. The orthopedist is still called upon to treat many of these patients, most of whom have had one or more previous operative procedures.

### PREPARATION OF PATIENT

The first step in the treatment of chronic osteomyelitis with sinus formation is bacteriologic. The organism or organisms present are cultured for identification as well as for determination of penicillin sensitivity. If the organism is not penicillin-resistant, the patient receives 40,000 units of penicillin every three hours, making a total of 320,000 units of penicillin for each twenty-four hour period. This is continued for at least four days before operation.



The next step in the preparation of the patient is the delineation of the ramifications of the sinus tract by the roentgenogram. The sinus tract is injected with diodrast forcibly introduced by means of a syringe with a large extended nozzle so that the operator's hands are out of the x-ray field; the nozzle is held tightly against the sinus mouth, thus permitting the complete extent of large sinuses with their bony connections to be visualized by the opaque medium. Immediately after the diodrast injection, stereoscopic roentgenograms are taken in both the anteroposterior and the lateral planes.

### OPERATION

The operation is performed a few days later, preferably under a tourniquet, as the extent of bone necrosis may be determined with much greater accuracy in a dry field.

The skin cicatrix, the sinus tract and the surrounding scar tissue are excised as completely as possible. With primary closure, if healthy soft tissue can be apposed to healthy soft tissue rather than to avascular scar tissue, primary healing is aided unless there is too much tension. In a number of cases sinus tracts were present for years without any bone involvement or disease. Such sinus tracts are relatively easy to excise and close. When, however, the sinus, as it usually does, enters the bone, then the operation must be more extensive. Cortical bone is removed with gouge and chisel until the cavity beneath is well exposed. The contents, which may be necrotic bone, sequestrum, infected granulation tissue or purulent material, are removed until healthy bleeding bone is reached. The overhanging angles of the cavity or cavities are then removed so that the bone is "saucerized." Deeply placed bone defects are not filled with bone chips unless the strength of the long bone has been seriously impaired. The bone defect is made smooth, washed, and all bits of bone debris are removed. At this point in the operation the tourniquet is removed. If there is extensive bone bleeding, gelfoam is employed as a coagulant to line the bone cavity whenever needed. Bleeding in the soft tissue is coagulated electrically. A meticulous closure is then performed, giving the bone as complete protection and covering with muscle, fascia and subcutaneous tissue as is possible. No sulfonamides or penicillin are used in the wound locally unless bone chips are employed. The deeper layers are closed with interrupted chromic catgut as fine as is possible, and the skin is closed with stainless steel wire, gauge 24. A sterile dressing is then employed with firm pressure over the wound, and the extremity is immobilized in a well-padded circular plaster. Upon return of the patient to bed the part is elevated.

### POSTOPERATIVE CARE

Postoperatively, the full dose of penicillin is continued for a minimum period of ten days, and at this time the cast and the stainless steel skin

sutures are removed. If the wound is well healed, if there are no signs of inflammation, and if there is no fever, the penicillin is stopped. However, if signs of inflammation continue, the penicillin and immobilization should be continued for a longer period. Early immobilization whenever possible minimizes metabolic disturbances in the extremity and permits earlier and fuller restoration of function. If bone grafts are to be used, a single stage operation is employed as skin retraction makes closure of flaps more difficult when multiple stage operations are carried out. Iliac bone grafts are taken by a separate surgical team, the usual site being the anterior or posterior wings of the ilium. In some instances when even more bone has been required, it has been obtained from the head of the tibia. Iliac bone is split into small fragments like match sticks, ideally 2 to 3 mm. in diameter and as long as possible. It has been demonstrated that the cancellous bone has greater resistance to infection than cortical bone. Originally, the bone chips were moistened with 2 to 3 cc. of saline solution containing 30,000 units of penicillin and 1 gm. of sodium sulfathiazole. More recently, penicillin alone has been employed. We agree with Sarjeant that the chips should be packed loosely and that they should cover the beveled margins of the defect.

Primary closure of skin defects after excision of scar and sinuses is essential, either by undermining the good skin on both sides, even to carrying the undercutting all around the limb, or by the use of multiple releasing incisions. Tension must be avoided to obtain success. The defects made by the relaxing incisions are covered by split thickness grafts, cut with the Paget dermatome, as the final step in the single stage procedure. Closures without tension have the added advantage of not impairing the circulation in the distal portion of the extremity.

#### ANALYSIS OF CASES

In the two-year period from July 1, 1945, to July 1, 1947, 30 patients have been operated on at the clinic by the above-described technics. The predominating organism in this series was the *Staphylococcus aureus*. The next most common was the hemolytic *Staphylococcus aureus*. Hemolytic streptococcus was present in 1 case and Friedländer's bacillus in 1 case.

Of the 30 patients only 2 failed to heal. One of these patients had a very extensive osteomyelitis involving nearly all of the femoral shaft, in which the Friedländer bacillus infection did not respond to the sulfonamide drugs nor to either penicillin or streptomycin, and this case finally came to amputation. In the other case, that of a middle-aged man, a *Staphylococcus aureus* infection of the lower tibial shaft recurred, probably because of inadequate saucerization.

The tibia was the bone most frequently involved, with 11 cases. The femur was involved in 10 cases, the humerus in 5, the bones of the

hands and feet in 3, and the following were involved in 1 case: ilium, pubic bone, sternum and spine. The chronicity of the cases in this series is noteworthy. The duration of symptoms varied from six weeks to thirty-six years, with an average duration of the osteomyelitis of nine and a half years. In one case, the sinus had drained continuously for thirty-six years.



Fig. 219 (Case 1).—Extensive cavitation and abscess formation involving entire wing of right ilium due to *Staphylococcus aureus*.

### ILLUSTRATIVE CASES

**CASE 1.**—This 15-year-old boy entered the clinic complaining of pain in the hip and low back region of one and one-half years' duration following a fall when he slipped on the ice. This fall was followed by an acute illness, with high fever and delirium, and he was hospitalized elsewhere for what was said to be a streptococcal blood stream infection. He was treated there with 2,000,000 units of penicillin and concomitant sulfadiazine. He apparently recovered without operative intervention.

When he was seen in the clinic a year and a half later, the boy was both chronically and acutely ill, with a large abscess over the posterior ilium on the right. The sedimentation rate was 98. The ilium was extensively involved with osteomyelitis (Fig. 219).

Aspiration of the abscess showed *Staphylococcus aureus*. After one week of penicillin therapy the entire wing of the ilium was resected. A very extensive osteomyelitic abscess was found, with three large apertures through the ilium. A copious amount of necrotic tissue was present. An anterior pocket extended down to the region of the obturator foramen, and a posterior pocket extended to the sacro-iliac joint and to the greater sciatic foramen. The wound was closed primarily and penicillin was given for two weeks postoperatively. The wound healed without

incident and has remained healed to the present time, one year after operation, without recurrence. He has gained 60 pounds since the operation. Figure 220 shows the postoperative result.

CASE 2.—This 48-year-old man came to the clinic in August 1947, complaining of a recurrently draining sinus in the left flank following a staphylococcic septicemia with which he was desperately ill in 1937. Recently, signs of an epidural abscess

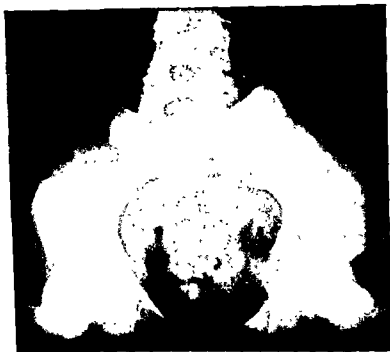


Fig. 220 (Case 1).—Resection of right iliac wing with penicillin therapy and primary closure resulted in cure.

had developed, with complete sensory and motor paralysis, except for the bladder, below the fourth lumbar segment.

Roentgenologic examination with diodrast injection of the sinus showed an irregularly branching tract which extended deeply and posteriorly to the level of the eleventh dorsal segment. Bacteriologic examination revealed *Staphylococcus aureus*. The roentgenograms also showed an osteomyelitis of the transverse process of the first lumbar vertebra.

On August 19, 1947, a laminectomy was performed by the neurosurgical department from the tenth dorsal to the second lumbar segment. No frank infection was found. The laminectomy relieved the cord pressure signs.

The wound healed uneventfully and September 3, 1947, a costotransversectomy, twelfth dorsal and first lumbar, was done, with excision of the osteomyelitic sinus tract. An abscess cavity was found anterior to the transverse process of the first lumbar vertebra.

The patient was given penicillin for three weeks after the operation. The wound healed uneventfully. He has had no evidence of recurrence.

CASE 3.—This 32-year-old man entered the clinic because of a large draining wound over the upper left tibia. This followed a compound fracture in 1934 due to an automobile accident. Because of the marked infection, the plate originally



Fig 221 (Case 3).—Osteomyelitis of the tibia following compound fracture, treated by block dissection of infected bone and split thickness skin graft.

used was removed. Union was secured by 1936, but since that time he had an active sinus (Fig. 221).

On examination there was a very extensive depressed scarred area over the face of the upper right tibia. The surrounding skin was reddened and inflamed. There was an indolent ulcer, measuring 4 by 4 cm., in the upper part of this depression which contained a sinus, with bare bone exposed. The infection was not deep, but involved the exposed face of the bone in the large indolent ulcer.

In November 1946 a left lumbar sympathectomy was done by the Department of Neurosurgery to increase the circulation of the part and promote healing. There was a good increase of warmth in the extremity following this procedure.

On November 20, 1946, saucerization of the left tibia was performed with block excision of the scar tissue. Because of the large skin defect, primary closure was impossible. Six days later, the wound edges were again debrided and a split thickness graft was placed in the defect. The take was only partial because of infection,

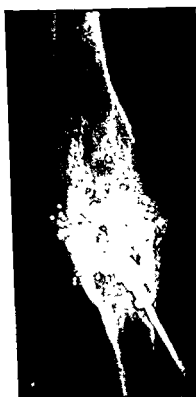


Fig. 222.

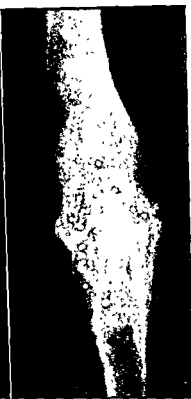


Fig. 223.

Fig. 222 (Case 4).—Osteomyelitis and destruction of knee joint following gunshot wound. Instrument with large nozzle for diodrast injection is shown.

Fig. 223 (Case 4).—Healing was achieved by sequestrectomy, saucerization, implantation of iliac bone grafts and primary closure.

following which zinc peroxide dressings were used, together with a sponge rubber pad over the ulcer. This was continued for five weeks and in this period the ulcer rapidly healed until at discharge healing was complete. This lesion has remained healed for over one year.

CASE 4 —This 31-year-old white man was first seen in consultation in March 1942. He had sustained an extensive gunshot wound of the right knee in December 1938. The articular surfaces of both femur and tibia were largely destroyed. Cir-

ulation and sensation in the extremity were impaired but survived the accident. Primary debridement, employing the Orr technic with immobilization in plaster, allowed the wound to heal incompletely. A sinus persisted anteriorly, from which there was an intermittent purulent discharge. The patient developed bowing of the knee posteriorly and laterally despite the use of a walking caliper.

Sequestrectomy and sulfonamide therapy in March 1941 had resulted in decreased discharge with continued pain in the extremity. Flexion of the knee was still possible through a range of 10 to 15 degrees from full extension. In addition, there was a large ulcer about the mouth of the sinus. An attempt to eradicate the infection and fuse the knee was advised.

The patient returned to the clinic in February 1946 (Fig. 222), still complaining of pain in the knee and discharge from the sinus. On examination, the knee was essentially unchanged, despite various operative procedures which had been carried out elsewhere in the interim.

The patient, thereafter, was admitted to the hospital on three occasions in 1946 and 1947. Saucerization of the bone defect, removal of sequestra and grafting with cancellous bone chips resulted in fusion of the knee and healing of the sinus (Fig. 223).

It is of interest that primary saucerization in July 1946 allowed a cavity to remain over which the skin flaps could not be closed without allowing "tenting" to occur, even though radical removal of the sclerotic bony margin of the cavity and the use of bone chips permitted closure, it was thought, without undue tension. The wound was healed when the plaster was removed after three months. Further discharge, however, occurred on two occasions. The scar was subsequently excised and closure was achieved with the use of relaxing incisions which were closed with immediate split thickness skin grafts in January 1947. The minute sinus in the original area finally healed in March 1947.

The patient returned to heavy construction work in July 1947 with the knee clinically and radiologically fused. Minimal discomfort remained when the patient was excessively fatigued. There has been no recurrence of discharge. There is no evidence of activity of the infection at the present time.

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# ANESTHESIA FOR UPPER ABDOMINAL SURGERY

EDWIN R. RUZICKA

THE ever-widening horizon of modern surgery is due to developments in anesthesia as well as to the increasing skill of the surgeon. Among the important considerations before any operative procedure is attempted are the comfort and safety of the patient and the operating conditions under which he must work. These factors assume major importance when surgical procedures in the upper part of the abdomen are necessary. Operative procedures such as those done on the pancreas and biliary tract require the utmost care and consideration. Nicholson<sup>4</sup> has carefully considered the problems which may arise in these patients. These details may be summarized under the headings of "preoperative preparation" and "premedication."

## PREOPERATIVE PREPARATION

In patients with biliary tract disease, irreversible pathologic changes, such as arteriosclerosis and hypertension, are often present. Other complications may be treated. The obese patient should be reduced. Vitamins A, B complex, C and K should be given to patients with vitamin deficiencies. Diabetes should be under control. Respiratory and urinary tract infections must be eliminated if present. Iron, liver and transfusions should be given if necessary. Very important is the attempt to repair a damaged liver by feeding the patient a high carbohydrate, high protein, low fat diet. More emphasis should be placed on diet than on intravenous administration of glucose to restore the damaged liver.

The jaundiced patient offers special problems. Vitamin K and oral administration of bile salts may be necessary to make the prothrombin time approach 100 per cent of normal. When a reversal of the albumin-globulin ratio exists along with a reduction in serum protein, high protein diet, intravenous amino acids and blood plasma are necessary to restore the serum protein to between 6 and 8 gm. per 100 cc.

In the presence of an external biliary fistula, abnormal blood calcium and phosphorus levels may be expected. Vitamin D and intravenous and oral calcium are useful in correcting this condition.

Preoperative serum bilirubin should be determined in patients with obstructed livers. The nonprotein nitrogen should be determined also and, if elevated, returned to normal. Progress in treating an obstructed liver may be gauged by repeated serum bilirubin determinations if necessary.

## PREMEDICATION

Preoperative medication serves the purpose of allaying apprehension, reducing metabolic activity and perhaps producing amnesia.

This may usually be accomplished with varying doses of pantopan, scopolamine and a short-acting barbiturate. The good risk patient under 50 years of age may receive pantopan,  $\frac{1}{4}$  grain, and scopolamine,  $\frac{1}{150}$  grain, subcutaneously two hours before operation and 3 grains of a short-acting barbiturate orally one hour before operation. The doses are reduced for older and weaker patients. A patient over 60 is not given a barbiturate. It is safer to be conservative in ordering preoperative medication for patients with liver disease. If necessary, additional medication may be given easily by the intravenous route in the operating room.

Jaundiced patients should receive only small doses of opiates and no barbiturates. When severe liver damage is suspected, it may be best to have no preoperative medication. Even small doses of premedication may result in profound narcosis and coma in these patients.

### INTRAVENOUS FLUID THERAPY

It is well to consider the method of administering fluids to patients undergoing surgical procedures in the upper abdomen. The surgeon needs exposure and room to work. The use of an armboard and the right or left antecubital vein for the administration of intravenous fluids is a satisfactory procedure. Better suited to upper abdominal surgery, however, is the use of foot, ankle or leg veins. These veins usually may be easily identified and the needle securely taped in place. There is then no undue crowding of the anesthetic and surgical procedures in one small area. The needle is more likely to remain securely in place in the ankle and is also easily accessible if adjustments need to be made. The accompanying illustrations demonstrate the use of veins in the ankle, leg or foot (Figs. 224 and 225). Also illustrated is the method for adding supplementary anesthetics or any other intravenous medication which may become necessary during the course of the surgical procedure.

Intravenous fluids must be administered during operation on the upper part of the abdomen. It is rare, indeed, that this type of surgery is done without use of a blood transfusion. It has become the custom, therefore, to begin intravenous fluid therapy with normal saline solution. This is chosen because the addition of blood to glucose solutions has on occasions been noted to cause clumping of the red blood cells. When physiologic saline solution is being used blood may be added to the intravenous set-up without delay. At the completion of the transfusion, any remaining blood cells may be washed through the set-up with normal saline solution and then glucose added if desired.

Emergency drugs, such as ephedrine, pitressin, neosynephrin and procaine, may be given through the intravenous tubing at any time and with very little delay.

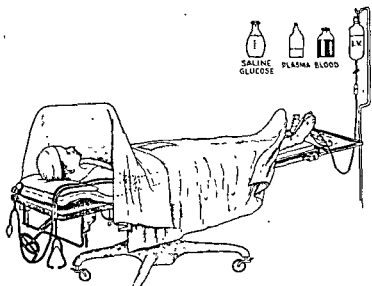


Fig. 224.—A method for administration of intravenous fluid, supplementary anesthetic agent or emergency drugs. Note the freedom of movement provided the anesthesiologist and the surgical team when both arms are at the side of the patient.

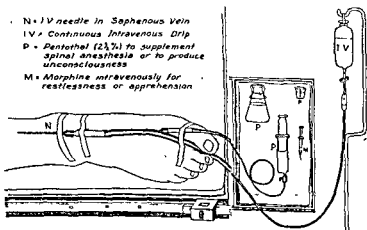


Fig. 225.—Detail of administration of intravenous fluid therapy or supplementary anesthetic agent. The extension at the foot of the table provides a satisfactory shelf for the storing and administration of agents which may be used.

### MODIFICATION OF THE SPINAL ANESTHESIA SOLUTION

The method of anesthesia must be as carefully considered as the preparation of the patient. All things being equal, spinal anesthesia is the choice for upper abdominal operations. Nicholson and Eversole's<sup>5</sup> report on neurologic complications following spinal anesthesia focused attention on this problem. They concluded that most spinal anesthetic drugs in the concentrations usually employed have a toxicity only a little short of that which would produce paralysis or other serious central nervous system complications in a significantly high percentage of cases. Following this report some modifications in technic have been developed designed to reduce the amount of spinal anesthetic agent used. A modification in the concentration of the pontocaine-glucose solution which is most often used in continuous spinal anesthesia is now in use. The solution formerly used most often consisted of 4 cc. of 1 per cent pontocaine in physiologic saline solution and 6 cc. of 10 per cent glucose. Divided doses were given as desired. This solution is now usually reserved for the husky, young vigorous patient in whom there is no suspicion of malignant disease. Usually, the solution now employed consists of 3 cc. of pontocaine 1 per cent, 5 cc. of glucose 10 per cent and 2 cc. of normal saline solution. Divided doses are administered from this reservoir as desired. The concentration now used is 3 mg. of pontocaine per cubic centimeter of spinal anesthetic solution. This solution provides satisfactory anesthesia and may be given in the same manner as the heavier solution, which is described later.

In the consideration of ways and means of reducing the concentration of drugs used for spinal anesthesia, the report of Potter and Whitacre on the use of pontocaine-dextrose-ephedrine mixture for subarachnoid injection must not be overlooked. These workers were able to demonstrate that the amount of pontocaine necessary to produce satisfactory anesthesia could be greatly lessened by adding ephedrine to the mixture of pontocaine and glucose. Their suggestion that the use of vasoconstrictors in the subarachnoid space along with the anesthetic mixture deserves to be carefully studied and re-evaluated, is worthy of careful attention. The initial report of these men would seem to indicate that there is real merit in the use of a vasoconstrictor such as ephedrine in the subarachnoid space along with the solution of anesthetic drug.

### THE USE OF CURARE

Another practice has been developed in an effort to lessen the amount of spinal anesthetic solution injected into the subarachnoid space during continuous spinal anesthesia for long operative procedures. This is the administration of 20 to 60 units of *d*-tubocurarine in place of the final dose of spinal anesthetic solution. This is usually done just before the peritoneum is closed. It is well to emphasize here that

curare is not considered to be an anesthetic agent but only a muscle-paralyzing agent.<sup>9,11</sup> No attempt is made to keep those patients awake undergoing upper abdominal operative procedures. Consequently, curare may be injected into the tubing of an intravenous solution already running, with the purpose of insuring muscle relaxation. The curare is not injected with the pentothal syringe or through pentothal tubing since a precipitate of acid pentothal may form when alkaline pentothal (pH 10.35) is combined with acid intocostarin (pH 5.1) or d-tubocurarine (pH 2.3). As Baird pointed out, this precipitate will go into solution in the blood stream but injection is not advised since the dangers of the acid precipitate are unknown and it is not possible to determine accurately the dose of acid pentothal injected.

It is now the regular practice to keep a syringe, needle and bottle of d-tubocurarine in the anesthesia machine in the operating room. To facilitate the use of the curare solution further, the needle and syringe are prepared for use and the needle inserted in the bottle of d-tubocurarine. In this manner, the curare solution is ready for instant use and may be employed for repeated injections and in different patients so long as the needle and syringe do not come in contact with blood and injections are made into intravenous tubing.

### SPINAL ANESTHESIA

As previously stated, the pontocaine-glucose solution now employed for continuous spinal anesthesia usually consists of 3 cc. of 1 per cent pontocaine in normal saline solution, 5 cc. of glucose 10 per cent and 2 cc. of normal saline solution. There is now 3 mg. of pontocaine in each cubic centimeter of fluid and the solution is still heavier than spinal fluid. The 30-inch length of tubing with a capacity of 2 cc. which is a familiar part of the special equipment used in continuous spinal anesthesia described by Lemmon is filled, leaving 8 cc. in the syringe.

The patient is placed in the left lateral decubitus position<sup>4,8</sup> on the special mattress so that his back is toward the side of the mattress containing the opening for the needle. Fifty milligrams of ephedrine sulfate along with a bit of the pontocaine solution for local anesthesia is injected in the spinal puncture site to maintain blood pressure as near normal as possible and to secure local anesthesia. This is usually the second or third lumbar interspace. The Moore introducer (Fig. 226, A) is then passed through the intraspinal ligament at this site. The needle is passed through the Moore introducer and spinal puncture is made. The needle is left in position while the Moore introducer is gently withdrawn. The Luer-Lok connection at the distal end of the tubing is securely connected to the needle.

The patient is then placed in the 10 degree Trendelenburg position and 4 cc. (12 mg.) or 5 cc. (15 mg.) is injected at the rate of 0.25 cc. per second. The patient is placed supine in a careful manner and without aid on his part. Since this solution is heavier than spinal fluid, the

head is, of course, elevated. The 10 degree Trendelenburg position is maintained for one minute and then the patient is returned to a level position by manipulating the table. Early and frequent testing of the height of spinal anesthesia must be done. The patient is placed in a level position in less than one minute if a satisfactory level of anesthesia is obtained. If the patient has not obtained a satisfactory level of anesthesia after one minute in the 10 degree Trendelenburg and then

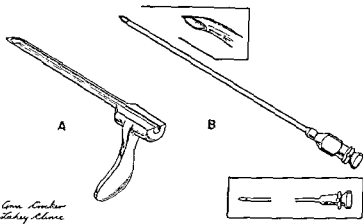


Fig 226.—A, Moore introducer which may be used for the insertion of any spinal needle but which is especially useful for the introduction of the malleable needle used during continuous spinal anesthesia.

B, The detail of the curved point and the notch at the top of the needle which is on the same side. The caliber of this Huber pointed needle is 16 gauge.

the level position, correction may be made by tipping the table downward 5 degrees for another minute. When anesthesia is within two segments of the desired level, it will probably progress to that level without lowering the head of the table. If the anesthesia has gone too high, the head of the table should be raised promptly to a 5 degree Fowler's position to prevent further cephalad flow of the anesthetic mixture. This maneuver does not lower the height of anesthesia but will lessen its intensity and shorten its duration.

The objections to continuous spinal anesthesia with an indwelling malleable needle which have been advanced include the difficulties in inserting the needle in the subarachnoid space, holding the needle accurately in place, and trauma to tissues from insertion of the needle. The possibility that the malleable needle might break must be considered. The use of the Moore introducer to guide the malleable needle is an answer to two of these objections. The needle may be inserted readily into the subarachnoid space and the trauma to tissues is no more than results from the introduction of an ordinary spinal needle.

When the malleable needle has been properly placed in the subarachnoid space and the patient very carefully turned on his back it is unlikely that the needle will become dislodged or broken. Whenever a free flow of spinal fluid cannot be obtained, the trouble may usually be corrected by a slight turn of the needle or by inserting the needle a very slight distance farther. This difficulty is usually noted immediately after the patient has been turned on his back so that the necessary corrective manipulations may be completed before the operative pro-

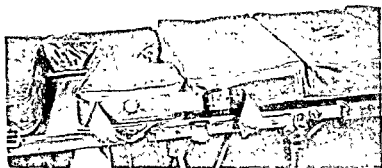


Fig. 227.—Thinning out of the mattress on either side of the opening provided for the needle during continuous spinal anesthesia. This is especially noticeable when a patient is placed on the mattress. Towels or small sandbags may be used to build the mattress up and keep the patient in a level position

cedure begins. If the manipulations are not immediately successful, the patient is placed on his side and the malleable spinal needle is then carefully reinserted. Another objection to this technic is the necessity for using a special operating table mattress. These mattresses are bulky, costly, and must be maintained carefully. It has been noted that the mattress after long use will lose its thickness on each side of the opening provided for the malleable needle (Fig. 227). The result is that patients do not lie flat on their backs but may be bent forward. There may then be a diminution of space allowed for the surgeon and difficulty in obtaining good exposure. This difficulty may be overcome by inserting folded towels or small sandbags under the mattress on each side of the opening provided for the needle.

Tuohy suggested the use of a ureteral catheter for continuous spinal anesthesia as a means of overcoming some of these objections. The procedure is to place the patient in a lateral decubitus position as for the usual spinal anesthesia and prepare the back in a sterile manner.



A spinal puncture is done at the site of the third or fourth lumbar interspace with a 16-gauge Huber pointed needle (Fig. 226, B). When the notch in the hub of the needle is pointed cephalad the point of the needle is in the same direction so that the catheter will pass in that direction. It must be noted that the 16-gauge Huber pointed needle will pass through the dura with no sense of the resistance which is usually noticed when the usual caliber spinal needle is employed. This must be remembered in an effort to prevent the trauma which such a large caliber needle might initiate. The  $3\frac{1}{2}$  French "Tuohy continuous spinal catheter" is graduated in easily recognizable 1 and 5 cm. markings. The catheter is passed through the needle until resistance is felt at the tip of the needle. This is noted at the 9 cm. mark. The catheter is then passed 4 to 5 cm. beyond the point of the needle. The Huber pointed needle is then withdrawn carefully in order not to injure the catheter. The catheter is brought up the patient's back behind the right shoulder. A patch of gauze is placed at the angle of the catheter with the back of the patient to prevent injury to the catheter from pressure at the point of emergence and turn of the catheter when the patient is placed on his back. The catheter is taped firmly in place and the patient is placed in a supine position. A 25 gauge needle is placed in the free end of the catheter. A 10 cc. syringe containing the anesthetic solution is attached to the needle by a one-way stopcock. The solution used is 3 cc. of pontocaine 1 per cent, 5 cc. of glucose 10 per cent and 2 cc. of normal saline solution. The initial injection may be 1 cc. (3 mg.) or 2 cc. (6 mg.) with the patient level but with his head elevated. The level of anesthesia is then checked carefully. This must be done on the lower extremities as well as on the thorax. If the level of anesthesia is satisfactory, supplementary anesthetic agent to produce unconsciousness and intravenous fluids may be started. Should anesthesia not include the legs it may be necessary to use local anesthesia to introduce the needle into a vein in the foot or ankle through which intravenous fluids or supplementary medication may be added. Spinal anesthesia is maintained by subsequent small injections of 0.5 cc. (1.5 mg.) to 1 cc. (3 mg.) about every thirty minutes. Should a satisfactorily high level of spinal anesthesia not be reached with the patient in a level position, 5 degree Trendelenburg position may be instituted with the further addition of a small amount of anesthetic solution (1 cc., or 3 mg.).

Saklad and his colleagues have presented a further use of the continuous spinal technic with the ureteral catheter. This involves the same technic as previously described with the exception that the ureteral catheter is advanced from 15 to 25 cm. cephalad in the subarachnoid space so that segmental anesthesia may be obtained by the injection of small amounts of dilute anesthetic solution in the direct vicinity of the nerve roots to be anesthetized. The anesthetic solution recommended by these workers is a 1:2000 solution of pontocaine

hydrochloride (0.5 cc. of 1 per cent pontocaine with 9.5 cc. of spinal fluid or normal saline solution); 2 to 4 cc. of this solution (1 to 2 mg.) is injected and levels of anesthesia are determined. It may be necessary to double the strength of this solution. The patient lies in the supine position. If anesthesia is inadequate additional injections are made (1 to 2 cc.). Subsequent small doses (0.5 to 0.1 cc.) may be needed every thirty minutes.

Anesthesia produced by this method requires great skill, attention to detail and careful watching of the patient. Injections must be made slowly and without force to prevent wide dispersal of the pontocaine solution with lowering of the concentration of the drug in the area desired and resulting inadequate and unsatisfactory anesthesia and operating conditions. Slow and gentle injection also serves the purpose of preventing the spinal anesthetic from going too high in the subarachnoid space. The most important complication to be guarded against is the breaking of the catheter while it is in the subarachnoid space. Catheters used for this procedure must be carefully inspected before and after each use and probably should not be employed more than six times under any circumstance. This is another disadvantage of the technic since the catheters are not inexpensive.

The question may arise that the policy of continuing to use spinal anesthesia while cutting down the concentration of the drug and finally replacing the last dose of spinal anesthetic solution entirely, seems a bit illogical. Why use spinal anesthesia at all? There are several reasons. The abdomen of a patient under spinal anesthesia is quiet and marked by relaxation and a contracted small bowel. There is no ballooning of the intestinal loops and they are well contracted. The breathing of a patient under high spinal anesthesia is quiet and almost unnoticeable. The breathing of a patient under curare is marked by very noticeable diaphragmatic movement. This may prove to be bothersome to the surgeon because of the jerky motion of structures in the upper part of the abdomen. It is usually necessary to intubate patients undergoing surgical procedures in the upper abdomen under some form of general anesthesia and curare. This is usually not necessary when spinal anesthesia and a supplementary anesthetic agent producing unconsciousness are employed. Curare is not an anesthetic agent.<sup>9,11</sup> Consequently, the patient must be held in at least the second plane of the third stage of anesthesia by an anesthetic agent when curare is used. This may mean unconsciousness for a variable period postoperatively with the necessity for a constant watch over the patient. When spinal anesthesia is used patients are asleep merely for their own comfort, nausea and vomiting are prevented and a quiet abdomen is insured. Many times these patients are awake before they leave the operating room. The difference and the advantage are obvious and are important when one considers the nursing shortage and the demands of a busy operating schedule.

While we are carefully considering the question of toxicity of spinal

anesthetic agents and means of lowering the amount used, it is thought that a record of 5 neurologic complications in 21,000 cases of spinal anesthesia is not a bad one, especially when 2 of the 5 patients were proved to have a cerebrospinal fluid block from metastatic carcinoma.<sup>8</sup> It is worth while to seek ways of preventing even these few complications but not of abandoning spinal anesthesia which can produce practically perfect operating conditions.

### SUMMARY

Spinal anesthesia with a supplementary or complementary agent producing unconsciousness is the anesthetic method of choice when surgical intervention in the upper portion of the abdomen is to be done. The number of neurologic complications following well managed spinal anesthesia is very low and probably no worse than those which follow the intelligent use of any anesthetic agent. The complications are distressing, however, and in an effort to reduce them several modifications in technic have been utilized. These include reducing the concentration of the anesthetic solution, the substitution of curare for the final dose of spinal anesthetic agent during continuous spinal anesthesia, the use of ephedrine in pontocaine-glucose mixtures, and the possibilities presented by the ureteral catheter method for spinal anesthesia.

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